Railway Mechanical Engineer

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Don't Abandon Convention Plans

All of the associations of officers having to do with the maintenance and operation of equipment, whose conventions were scheduled for August and September, have found it necessary to cancel arrangements for their regular dates owing to conditions created by the shopmen's strike. Two of these organizations have already fixed dates for holding postponed meetings and in doing so have set an example which all of the others may well follow as soon as circumstances will permit. The permanent cancelling of plans for conventions this year will, for most of the organizations, mean a period of two years during which no meetings have been held. This is a serious matter to the health and prosperity of the organizations. But, of even greater importance, it represents the loss of an opportunity for effective work by these associations at a time when it will be greatly needed. The strike, with the shifting of men from one shop to another, has entailed a serious impairment of working morale which even an immediate settlement of the controversy on a basis entirely satisfactory to the labor organizations could not restore, and however effective the forces built up during the past two months may have been in keeping the equipment in service, this effectiveness has been obtained by a resort to temporary emergency measures too expensive to be established on a permanent basis. During the next year the supervisors in the mechanical department will be faced with the task of developing the new forces into efficient working organizations. If the associations of these officers have any real function to perform, certainly the present situation offers to them a splendid opportunity for the inspiration and encouragement of their members through an exchange of ideas as to how best to accomplish the difficult task ahead of them. It is to be hoped, therefore, that these associations will plan to hold their conventions later in the year.

Value of Accessible Data

Each step forward and each new bit of knowledge is founded on what has been done before. This is true in all domains of human activity, regardless of their nature and applies to designs of locomotives, cars, or machinery and to methods of doing work, as well as to chemistry, science and management. What a man is able to accomplish often depends less upon what he actually knows than upon his ability to place his hand promptly upon a mass of accumulated data when it is wanted. An education from study and experience is not the filling of the brain with a lot of miscellaneous information but is a broadening of the range of vision so that a person knows where and how to obtain full and accurate information on any particular subject. Practically everyone reads, sees or hears of something every day that is new to him and which he thinks may be usefully applied sometime. Unless one makes a note of and properly files the information, it is apt to be forgotten or overlooked at the time when it may be used. As a convenient method of filing away a vast amount of data which will be available when required, nothing equals a small card index. It is wonderfully flexible and can be modified to suit any individual requirement. If desired, cards may be carried in the pocket on which notes can be made of an article read; a book seen; the time taken, the method used or expense of doing a piece of work; a new machine for a certain operation, or anything else of interest. Every year sees an increasing use of this little device which is just as valuable for the foreman or the apprentice as for the professional man or the executive. Are you making full use of this aid in your work?

Erie Cuts Down Air Losses

A valuable article entitled, "Pneumatic Power and Transmission Losses," which describes the successful efforts of the Erie to locate and stop air losses at various points on the system, will be found on page 529 of this issue. Some extremely bad conditions as regards the wasteful transmission and use of compressed air were found by the Erie investigators. Doubtless these conditions were no worse than now exist on many other roads which could profitably follow the example of the Erie in ferreting out air losses and stopping them.

The direct money loss taking place every day in probably the majority of railroad shops as a result of air losses is all too little appreciated. As pointed out in the article, air losses in compression, transmission and by illegitimate uses have a direct effect upon the coal pile. Moreover, air leaks result in inadequate pressure on the shop lines which has a serious effect on the production of men using pneumatic tools and devices throughout the shops and yards.

One of the striking examples mentioned is a terminal yard where, due to leakage in the transmission line beneath the ground, there was a drop in pressure of 28.8 lb. between the air compressor and terminal tower. The renewal of practically all of this transmission line was found necessary and resulted in bringing the pressure in the terminal tower practically up to that in the compressor room. Train movements were speeded up by the more effective operation of the electro-pneumatic switches and in addition, approximately 450,000 cu ft. of air was saved each 24-hour day with an estimated saving in fuel of almost $5,000 a year. The money saving alone was large and anyone who has tried to operate a pneumatic drill or hammer on insufficient air pressure can appreciate how much adequate pressure increases shop production. Tests should be made at the earliest opportunity in every railroad plant in the country to make sure that preventable air losses are not occurring daily in compression, by leaks in transmission, or by wasteful and unnecessary methods of use. In addition, it should be determined if the undue extension of air lines and air-consuming devices has not reduced air pressures below the point at which pneumatic tools operate efficiently. If so the result is a decreased shop production which can be ill afforded at the present time.

Meaning of the Term "Wood Butcher"

The railroads of the United States consume millions of feet of lumber annually and "wood butchers" is the apt term applied to some shop men who attempt to work up this lumber into any of its almost infinite uses, employing planers, saws, chisels, bits or other woodworking tools which are dull and, therefore, unfit for use. A sharp tool will cut wood almost like cheese, requiring little effort and leaving a smooth, accurate job. If the cutting tool is dull, on the other hand, a surprising amount of energy is required to operate it and when the work is done, it is far from satisfactory. Car shop men as a rule know the above facts but some of them become careless at times and rather than take the trouble to sharpen their tools, operate them dull. Apprentices and new men in the shops particularly should be made to appreciate the value of sharp woodworking tools both in decreased power required to operate them and increased production of car shop and mill room.

With many of the tools, particularly hand planer knives, chisels, etc., it is merely a question of care and attention in grinding and whetting. With other tools, like circular saws, however, it is practically impossible to perform the operation of sharpening with a hand file as satisfactorily as it can be done on some type of automatic or semi-automatic sharpening machine. Saws should have the right hook and pitch of teeth and the right amount of throat or gullet for the work at hand. Saw teeth should be uniformly spaced, uniformly shaped and evenly set or swaged. Obviously a machine can perform this work with far greater regularity, less effort and more all around satisfaction than would be possible by hand. The provision of modern saw-sharpening machinery is necessary in shops doing any considerable amount of woodworking. With saws and other woodworking tools kept sharp and in good working order, the application of the term "wood butchers" to car shop men will not be justified.

Car Wheel Loads and Rail Stresses

Until recent years comparatively little attention has been given to the stresses set up by impact of freight cars, either in the rail or in the car. With the increase in the capacity of freight equipment, the wheel loads have increased until they are now in some cases practically as great as on locomotive driving wheels and some engineers are inclined to think that the effect of these extremely heavy loads on car wheels is quite as serious as an equal load on a locomotive driver. Although the effect of the counterbalance in increasing the stress on the rail is absent, the wheel is smaller, the distance between wheels is greater and the coil springs may go solid, all of which tend to increase rail stresses. There is evidence which indicates that on some divisions more broken rails may be caused by heavily loaded cars than by locomotives. Probably further investigation will prove to what extent cars are responsible for rail breakage. In the meantime, designers may well keep on the safe side and build cars so that they will not be likely to cause excessive impact loads.

Most of the destructive impacts from freight cars are caused by the springs going solid and if stresses are to be kept down, this must be avoided. One way to do this is to increase the capacity of the truck springs, which would also be desirable because it would probably reduce the number of spring failures. If a high-capacity coil spring was not satisfactory, a leaf spring might be used. Experiments have shown that coil springs on freight cars go solid only because of variations in load synchronizing with the period of vibration of the car. The friction between the leaves of an elliptic spring would damp the oscillations and should prove effective in avoiding excessive impact.

The Scrap Pile Teaches a Lesson

Railroad men of long experience maintain that the scrap pile is one of the best places to go for an indication of the efficiency of shop operation. Certainly many lessons can be learned from the scrap pile by both shop men and higher mechanical department officers. Many locomotive and car parts fail in service and are scrapped due either to defective material or design. Reducing these service failures to a minimum is a job worthy of, and requiring the closest co-operation of mechanical engineers, engineers of tests and practical shop men. When a driver brake fulcrum, or adjusting rod, for example, fails in service from an evident defect in design, why should not the mechanical engineer's office profit by the experience of the blacksmith foreman in developing a new design which will have the requisite strength? Not only is the up-to-date blacksmith foreman a good judge of the strength of metal, but he is also familiar with the details of forging the redesigned part and, in the case of two designs having possibly equal strength, he will be able to decide which is the quicker and more economical to make. In far too many cases weaknesses in design are corrected at the expense of unnecessary manufacturing cost. Shop foremen, like all other railroad men, have pet hobbies and not all of their suggestions for improvement in design could probably be accepted, but it stands to reason that with their long experience in making, repairing, dismantling and assembling locomotive and car parts they see many points where small changes in design would eliminate breakage or reduce the cost of making and applying. Advantage should be taken of their experience to the fullest possible extent.

Are Railroad Shops Inefficient?

Ever since the flood of would-be reformers, misnamed efficiency engineers, descended on the railroads about ten years ago, it has been the fashion to criticize railroad shops as being poorly managed. The promises made by the efficiency engineers have never been fulfilled but their comparisons of methods in industrial plants and railroad shops, always unfavorable to the latter, are still being repeated. Probably no railroad shop foreman would deny that in some particulars the railroads can learn valuable lessons from manufacturers but it is only right that they should resent and combat the oft-repeated statements reflecting on the management of their plants.

It is probable that when all the circumstances are considered, the average railroad shop is as efficiently operated as the average industrial establishment. The workers in both cases are drawn from the same classes and have approximately equal opportunities. There are just as good brains among railroad men as will be found anywhere else. Any number of instances could be cited where railroad men who have gone into industrial plants have developed improved methods and have made good most decisively, but the industrial experts who have promised to revolutionize railroad shop methods have yet to prove their case.

The statement is often made that railroad shops are not as efficient as industrial plants because they are not spurred on by competition. Those who make this statement should realize also that the absence of competition is a very good reason why railroad practice should differ from that in manufacturing plants. The best method for the manufacturer is the one that will enable him to sell his goods to the best advantage; finish and appearance are usually important factors. The railroad on the other hand need only consider the method that will give the lowest cost per ton and passenger-mile, and oftentimes would not find it economical to use the same refinements as the manufacturer.

Railroad men are no doubt right in their contention that

locomotive and car shops present a special problem and cannot fairly be compared with manufacturing plants. Probably the most satisfactory comparison would be between railroad shops in our own and foreign countries. Engineers who have studied the methods used abroad generally agree that while other countries may put a finer finish on locomotives, for high output and low costs American railroad shops are in a class by themselves. One foreign visitor recently said that all the shop methods in his country could be improved by copying American practice. This would surely apply to the locomotive shops in Germany also, judging by a recent article in a German railroad magazine which pointed out methods of avoiding superfluous labor. These included rolling boiler tubes with an air motor instead of by hand and setting valves with rollers (turned by hand) under the main wheels instead of moving the locomotive along the track with pinch bars. The latter improvement is especially interesting as it has been obsolete in this country for 20 years. On the whole, it seems that the men who operate American railroad shops are doing as well as anyone could under similar conditions. It is easy to find fault but the critics of the railroads do not deserve a hearing until they prove that they can effect some real improvement, which up to this time they have not been able to do.

Progress in Locomotive Design

About ten years ago the American Locomotive Company built its experimental Pacific type locomotive, No. 50000. It established records that have seldom been equalled since and represented the highest development of railroad steam motive power at that time. Another experimental locomotive, Michigan Central No. 8000, described in this issue, is now receiving considerable attention from railway mechanical men. This, like its predecessor, has been designed with extreme care and embodies all the latest appliances. While the locomotives are of different types, one being intended for passenger and the other for freight service, it is interesting to compare the two designs and note the changes in the most advanced practice of ten years ago and of today.

One of the objects sought in No. 50000 and in No. 8000 was the elimination of superfluous weight. In both cases a considerable reduction in weight was secured as compared with prevailing practice, but apparently there is very little difference between the two locomotives in this respect. A comparison on the basis of rated boiler capacity, though not conclusive, indicates that the ratio of weight to power is about the same. The appliances used on No. 8000 may have a noticeable effect on the power output and it will be interesting to compare the results of road tests when they are available.

To save fuel No. 50000 was fitted with a carefully designed boiler having a superheater and a brick arch. No. 8000 likewise has a high capacity boiler. The tubes are larger than in No. 50000, the superheater is designed to give a higher temperature, the brick arch is arranged to secure increased circulation of the water in the boiler and mixing of the gases of combustion in the firebox, and the feedwater heater by reclaiming heat from the exhaust steam reduces the fuel consumption. With these improvements it is reasonable to expect the new locomotive to give a considerably better performance than the design of ten years ago.

Another important characteristic of any locomotive is its hauling capacity. At high speeds this is dependent on the boiler output which has already been discussed. At low speeds No. 8000 has a decided advantage because the booster utilizes the weight on the trailing truck to obtain additional tractive power, thus bringing a very large proportion of the total weight of the locomotive into play as adhesive weight when starting. On the whole, the notable Michigan Central Mikado may be expected to show enough improvement over No. 50000 to demonstrate that the last decade has added its full share to the progress of the steam locomotive.

Cranes and Trucks for Railroad Shops

No locomotive erecting shop, heavy machine shop, boiler shop, blacksmith shop, foundry or other building for heavy work is properly equipped unless it is provided with a sufficient number of overhead traveling cranes of a suitable capacity and speed. While such cranes are of vital importance, it is desirable to investigate the way in which they are utilized and the cost, for example, of moving a load from one end of a shop to the other. A careful analysis of a day's expenses for crane service in any shop will often show some rather unexpected facts. In such expenses should be included not only the operator's time, power, maintenance and overhead, but also any time that may be lost in waiting for crane service. This last item is at times quite a serious one in some shops, one very difficult to hold to the minimum. In addition to delays while waiting for service, it is not unusual to see a crane of large capacity called on to lift a small load or even used to transport it the full length of a long shop. It should be remembered that a crane is fundamentally a hoisting machine and afterward a transporting device. For transporting purposes it is not an efficient type of mechanism and where possible other forms of material handling machinery can be used to better advantage. The shop output frequently can be increased and general cost of operation decreased by the addition of small stationary jib cranes, a wall jib traveling underneath the overhead crane runway, monorail cranes or some form of overhead carrier. Of these, the two last are more frequently valuable where the loads are not very heavy. During recent years there has been a marked development in the design of storage battery and gasoline trucks and tractors and these are now available in many types and sizes. A very useful form of such a machine for roundhouse or shop is one equipped with a power crane having a long jib arm. Industrial trucks are free to travel from one bay to another, or from one building to another. If the proper type is selected attention is given to routing, trucks and tractors are highly economical and serve to relieve cranes of work for which they are least adapted.

NEW BOOKS

PROCEEDINGS OF THE MASTER BOILER MAKERS' ASSOCIATION, 1922. *Edited by the secretary, Harry D. Vough, 26 Cortlandt street, New York. 208 pages, 6 in. by 9 in. Bound in cloth.*

This book contains the proceedings of the tenth annual convention of the Master Boiler Makers' Association which was held in Chicago, May 23 to 26, 1922. The reports submitted included oxyacetylene welding, electric welding, advantages of various types of crown stays, methods of welding safe-ends on boiler tubes, prevention of deterioration of fireboxes behind grate bars, cause of cracking through girth seam rivet holes or on circumferential seam and best type of side sheets for narrow and wide fireboxes. The discussion of many of the papers was quite complete. This applies particularly to welding processes.

INTERNATIONAL RAILWAY CONGRESS.—The Permanent Commission of the International Railway Association has announced that the next congress will be held in London during the latter half of 1925. This time is selected in order to participate in the centenary of the first English railway. The questions to be discussed will be limited to three for each of the five sections; way and works, locomotives and rolling stock operation, general, and light railways.

WHAT OUR READERS THINK

Why College Men Do Not Stay in Railroad Service

LOUISVILLE, KY.

TO THE EDITOR:

In the August issue of the *Railway Mechanical Engineer*, there is a question which puts in an appearance periodically, as to why college men do not continue in the railroad business. Various answers have been set forth from time to time under a variety of captions. If the writers have not all said the same thing substantially in dealing with this query, they have endeavored to do so and the amount of difference between their opinions is small.

I have met college men who thought they wanted to acquire the knowledge necessary to equip themselves for railroad service, but they were puffed up to such an extent that the details of the business were a bore to them. They could not or would not get down to the practical things which are so essential in supervisory work. They never learned to adjust spring rigging, quarter a pair of driving wheels or fit a crank pin, but they could hang guides, fit shoes and wedges and set valves. They obtain just enough general information and linger long enough to enable them to say, "We took a special course in so and so shop and are now ready to set the world afire."

Coming right down to brass tacks, the railroad shops are in need of intelligent men; not of this brand or the other, but men who know how to think and do it quickly and accurately. Not drivers so much as leaders, not doers entirely, but *knowers*, i. e., to be able to tell in a few words what is wanted and to be sure of the results. Such knowledge can only come with experience and this is like the time difference between growing a squash and an oak. It requires a great amount of patience and perseverance to reach the top rung in the railroad business. We can not kill the old guard even if we desired to do so, and we are helpless when it comes to pushing a faithful one out to make room for an ambitious, untried person. And so the lane is a long one and the turn seems out of all earthly sight, but such is not the case. It is right where it should be, awaiting the persevering one.

The reason why a college man does not stay is not because he is unappreciated, but because of his lack of patience. A real railroad man requires quite an equipment besides the one he gets from his Alma Mater; he needs to take on a good stock of cheer, a fair supply of diplomacy and full tank of genuine Job-like patience—and then work like the deuce until the reward comes. It may perchance not come in the form he would most desire it, but it is sure to follow if he persistently hangs on. I have never yet seen the above rule to fail.

This then, is my answer to the oft propounded question—it is because the average shop boy outwaits the average college man and wins over him on account of bull-dogish-hang-on-itiveness.

I can not leave this subject without venturing a practical solution, which is a *bang up compulsory apprenticeship system* in every railroad shop throughout the country with first class instructors—men possessed of character as well as mechanical skill and knowledge.

Since we can not hold the college men, let us see to it we get the next best thing.

MILLARD F. COX,
Mechanical Engineer, Louisville & Nashville.

Waste of Steam with Extremely Long Cut-Off

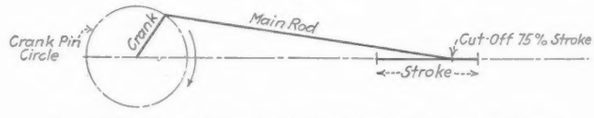
KANSAS CITY, MO.

TO THE EDITOR:

In helper and freight service on long grades where it is the custom to work the engine with valves cutting off, at or near full stroke, a waste of steam results from the use of a cut-off later than 75 per cent of the piston stroke without any appreciable gain in power. The angle formed by the main rod and crank-pin is such that little turning effect is imparted to the driving wheels during the last quarter of the stroke.

That this fact has been recognized in Europe is proved by the latest design of una-flow locomotives which exhaust at 75 per cent of the stroke. While this early exhaust is primarily intended to shorten the cylinders, it would not have been adopted had it proved in any way detrimental to the engine's performance.

To further support the above statement I will quote an extract from a series of tests that were conducted by a large eastern road in which a Mikado type locomotive developed



Power Obtained from Last Quarter of Stroke Is Slight

1,320 hp. at 90 per cent cut-off on a steam consumption of 31.6 lb. of steam per horsepower hour at 40 r.p.m., while with a 75 per cent cut-off at the same speed it developed 1,300 hp. on a steam consumption of about 25 lb. per horsepower hour, which shows that it is possible for an engineman to waste 25 per cent of the steam used with practically no gain in power.

As a further example, take the average Mikado locomotive with 27 in. by 32 in. cylinders and 200 lb. steam pressure with maximum cut-off of 90 per cent (which is generally adopted) and observe the increased steam consumption per revolution by cutting off at 90 per cent stroke instead of 75 per cent.

With 90 per cent cut-off the piston has traveled 28.8 in. of stroke. With 75 per cent cut-off the piston has traveled 24 in. of stroke, a difference of 4.8 in.

The area of a 27-in. piston is 572.5 sq. in.

$572.5 \times 4.8 = 2{,}748$ cu. in. $= 1.59$ cu. ft.

1 lb. of steam at 200 lb. pressure occupies 2.12 cu. ft.

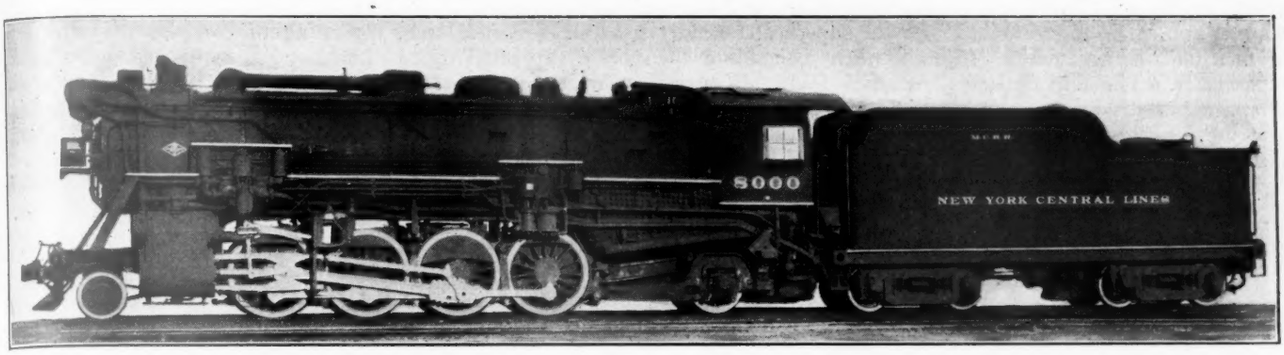
$1.59 \div 2.12 = 0.75$ lb. extra steam consumed per stroke.

As there are four strokes in two cylinders per revolution $0.75 \times 4 = 3$ lb. extra steam consumed.

From the above it will be seen that enormous quantities of steam may be wasted on long grades.

In conclusion I may say that most English locomotives have a maximum cut-off of 75 per cent of stroke and that no difficulty is experienced in starting with a full load.

P. D. ANDERSON.



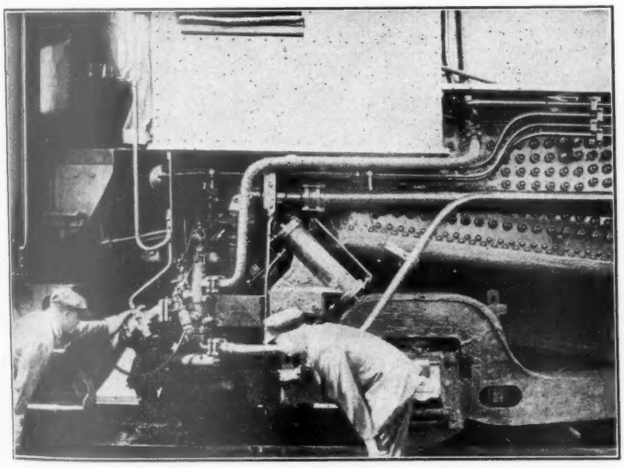
Left Side View of Michigan Central No. 8000

New Michigan Central Mikado Has Many Special Features

Modern Appliances Co-ordinated To Give Maximum Efficiency; Refinements in Design To Reduce Weight

FEW locomotives built in recent years have created as much interest as the special Mikado type, No. 8000, built for the Michigan Central by the Lima Locomotive Works, which was described briefly in the *Railway Mechanical Engineer* for August, 1922, page 437. Further details including drawings, have now been made available.

As outlined in the earlier article, the object of the design was to provide the maximum hauling capacity with the minimum fuel consumption and without exceeding the allowable limit of weight. The Michigan Central was already using a very well designed Mikado, designated as type H7E, and the problem of effecting a marked improvement over the performance of this locomotive was a difficult one. That a satisfactory solution was found is indicated in Table I.



Rear of Locomotive, Showing Stoker, Booster and Grate Shaker

It will be noted that with an increase of 1.8 per cent in total weight, the maximum tractive force without the booster has been increased 7.6 per cent and with the booster, 26.3 per cent. The weight per cylinder horsepower, based on Cole's method, has been decreased 5.1 per cent. This does not take into account the improvement in performance due to the feedwater heater, high degree superheat and the operation of auxiliaries with superheated steam. The estimated performance curve shows a maximum of 3,070 cylinder horsepower, an increase of 17.0 per cent and a decrease of 12.8 per cent in weight per cylinder horsepower.

The figure for the boiler horsepower of No. 8000 by Cole's method is an approximation because only incomplete data are available regarding the evaporation from 3¼-in. boiler tubes. The figures are given to afford a comparison of the two boilers on the basis of a steam consumption of 20.8 lb. per horsepower hour. While any prediction of the water rate for this locomotive is subject to error, 18 lb. per horsepower hour does not seem too low. At this rate the estimated boiler output would be 3,160 hp. and since the feedwater heater increases the steaming capacity, the evaporation should be fully up to the cylinder requirements.

TABLE I—COMPARATIVE DATA FOR CLASS H7E AND NO. 8000

	Class H7E	No. 8,000	Increase Per Cent
Weight on drivers, lb.	246,000	245,500	0.2*
Total weight, lb.	328,000	334,000	1.8
Cylinders, diameter and stroke	27 in. by 30 in.	28 in. by 30 in.	...
Tractive effort without booster, lb.	59,000	63,500	7.6
Tractive effort with booster, lb.	.....	74,500	26.3
Cylinder horsepower, maximum (Cole)	2,624	2,824	7.6
Weight per cylinder horsepower (Cole), lb.	125	118	5.1*
Cylinder horsepower, maximum, estimated from performance curve	.....	3,070	17.0
Weight per cylinder horsepower, estimated lb.	.....	109	12.8*
Boiler horsepower, maximum (Cole)	2,420	2,735	13.0
Weight per boiler horsepower (Cole)	135	122	9.6*

*Decrease.

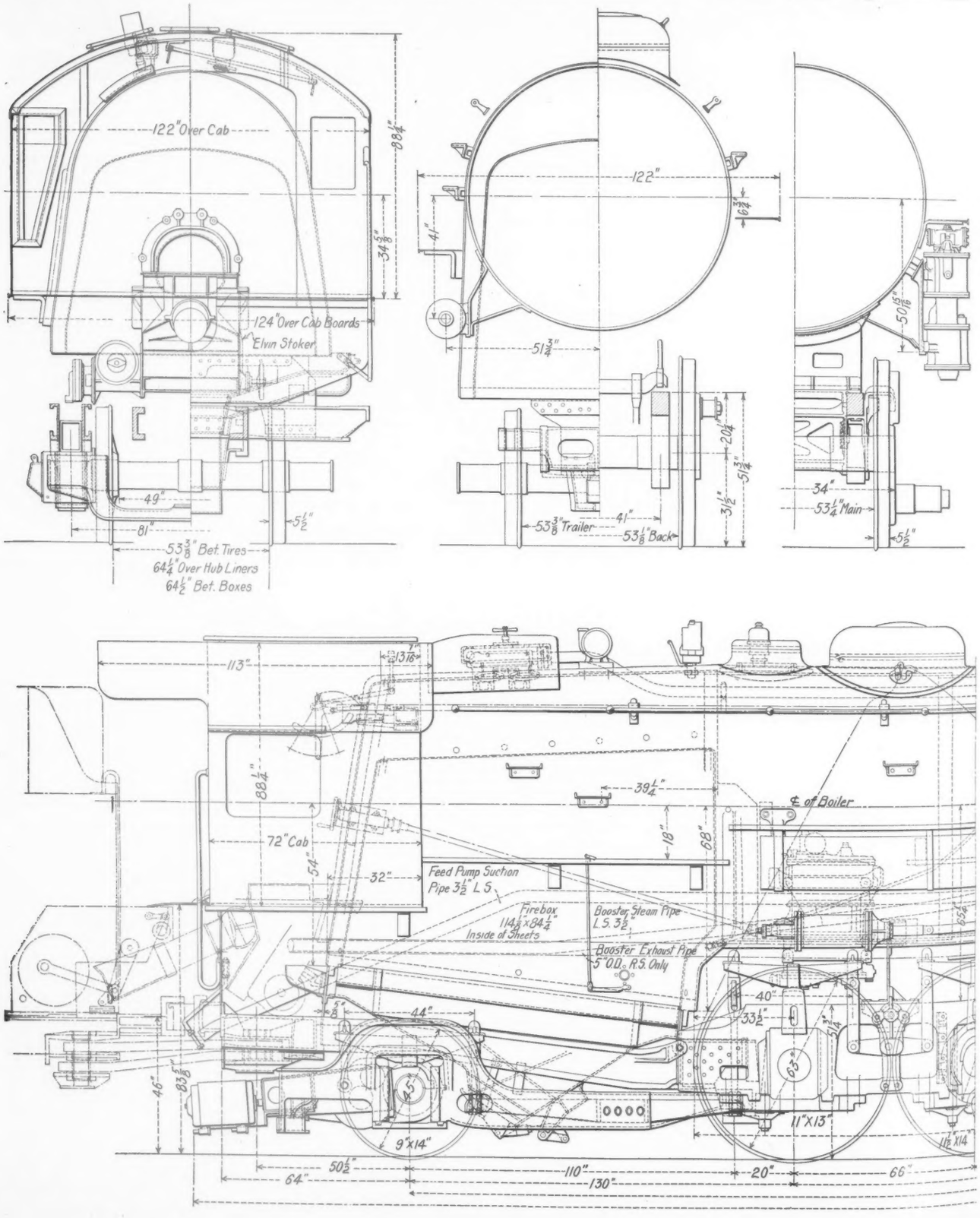
Another primary consideration in the design of No. 8000 was fuel economy, not necessarily the burning of less fuel than previous locomotives, but the ability to obtain greater drawbar output for the fuel consumed. This object was attained by incorporating into the design well-known fuel-saving devices properly proportioned with respect to the locomotive and its appliances to give the best results.

The Superheater Company's type *E* superheater is used and provides steam for all auxiliaries as well as the cylinders. This design of superheater permits of using but one size of tube and the entire boiler is equipped with 3¼-in. tubes. A large proportion of these tubes contain superheater units and the steam is raised to a higher temperature than is obtained from the usual type *A* superheater. The design also provides a greater total steam area through the units than the type *A* and at the same time permits of greater gas area through the tubes. In view of this greater gas area, more heat is absorbed from the gases before they pass into the smokebox and consequently there is a better boiler and superheater performance and less heat is lost through the stack. The damper usually found in the type *A* superheater has been omitted because the throttle is ahead of the superheater and protection to the units is afforded by the flow of steam through them for the blower and the other auxiliary apparatus when the main engine is shut off. A removable

plate is applied to the smokebox over the superheater header to facilitate the tightening of joints when assembling the superheater. The Superheater Company's feedwater heater is applied which utilizes a portion of the exhaust steam to heat the feedwater from tank temperature to about 225 deg. F., the condensate being returned to the tender.

The firebox is supplied with coal by an Elvin stoker and is equipped with the American Arch Company's type *P* double firebrick arch, consisting of two sets of refractory brick supported on two horizontal rows of arch tubes, each comprising four 3½-in. tubes. This design of firebrick arch is new. Its purpose is not only to ensure complete combustion, but to improve water circulation in the boiler, the chief object of the double rows of arch tubes.

Additional economy of steam is secured by the use of superheated steam in the auxiliaries, including the air com-

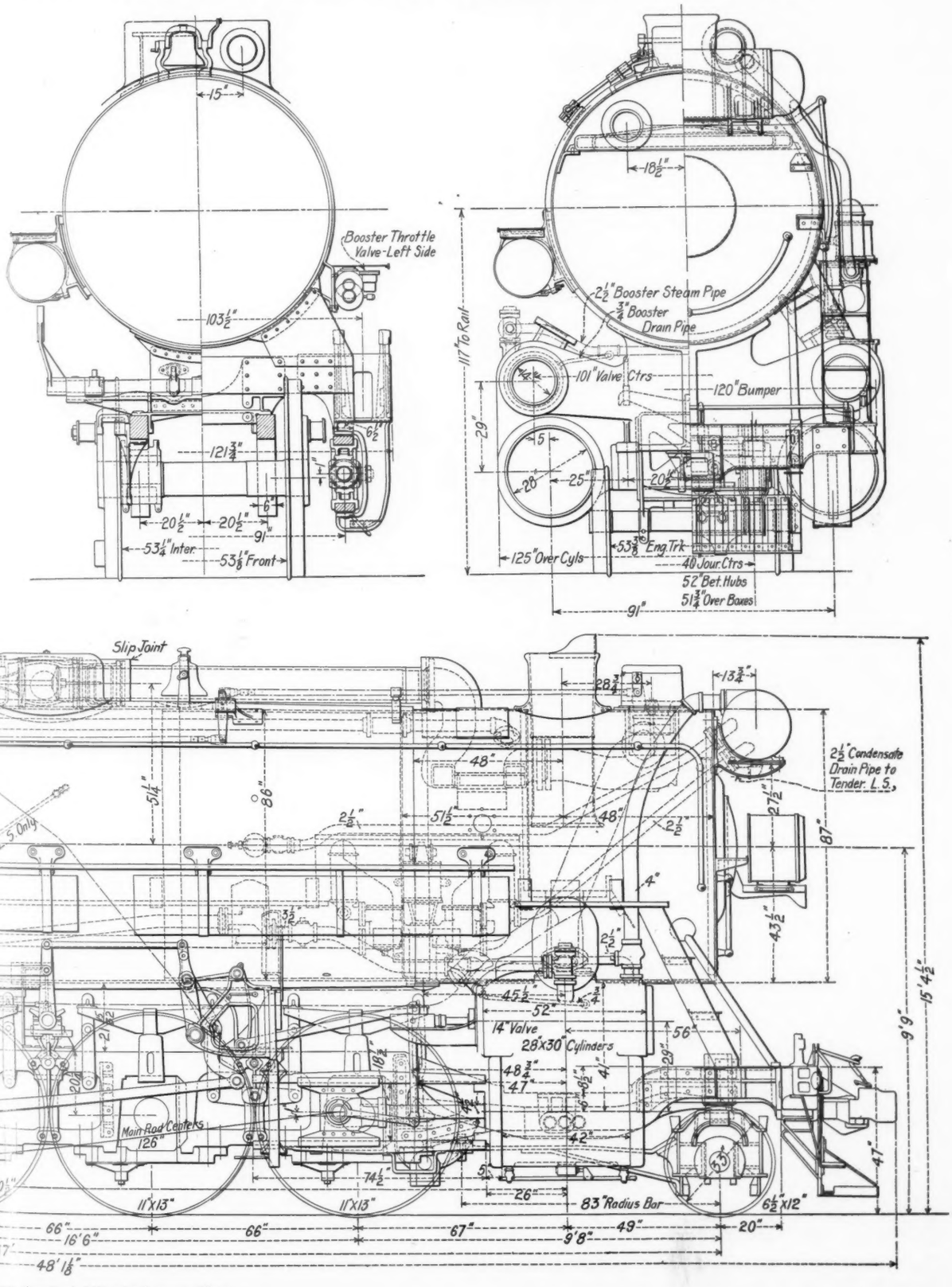


Side Elevation and Sections of

pressor, feedwater pump, blower, turbo-generator, stoker and locomotive booster. These accessories at times use more than 25 per cent of the steam from the boiler. The consumption per unit of work done is quite high and the saving by superheating the steam should be relatively large.

Reduction of Weight and Dynamic Augment

Careful attention was given to all the details of design to eliminate every pound of unnecessary weight. Little opportunity for reduction was found in the boiler or frames, but surprising savings were made in some of the minor details. For example, by refinement in design, the foundation brake rigging was cut down 1,800 lbs. without sacrificing strength. The use of magnesia lagging saved several hundred pounds. One of the reasons for the selection of the Elvin stoker was its relatively light weight.



Michigan Central Mikado Locomotive

To keep down the weight of the locomotive, the axles and main crank-pins were made hollow and Lima special quality steel, which is a chrome-vanadium steel heat treated by annealing, was used in main and side rods. Great care was also exercised in the design of the reciprocating parts so that not only was a saving made in the static weights, but it was also possible to reduce the dynamic augment, or pressure at the rail due to excess counterbalance. Table II indicates the relative dynamic augment of Class H7E, and No. 8000 at operating speeds of 30, 40 and 50 miles per hour. The reduction of 52 per cent in the maximum dynamic augment shows the advantage of the high-quality steel used in the running gear.

Table II—Dynamic Augment of Class H7E and No. 8000

	30 m.p.h.		40 m.p.h.		50 m.p.h.		Decrease,
Wheels	H7E	8000	H7E	8000	H7E	8000	per cent
Front	3,430	1,920	6,100	3,420	9,520	5,340	44
Intermediate ..	4,040	1,920	7,180	3,420	11,200	5,340	52
Main	2,040	1,470	3,630	2,610	5,680	4,080	28
Back	3,510	1,860	6,240	3,300	9,750	5,160	47

Special Features of Construction

In order to attain the objects sought in the design of No. 8000 many innovations were made in the construction. The special features are the subject of patents now pending.

The boiler is of the straight-top type and carries 200 lb. per sq. in. pressure. The barrel has an outside diameter of 86 in. at the first ring and contains 253, 3¼-in. flues, 20 ft. long. The firebox has a grate area of 66.4 sq. ft. There is no combustion chamber but, as mentioned above, a double arch is applied on eight arch tubes. One of the interesting details is the large mud-ring corners which have a radius of 12 in. This easy curve makes it possible to apply rivets instead of patch bolts, improves the circulation around the firebox and facilitates inspection and cleaning. The heating surface of the firebox and arch tubes is 291 sq. ft. and of the flues, 4,287 sq. ft.

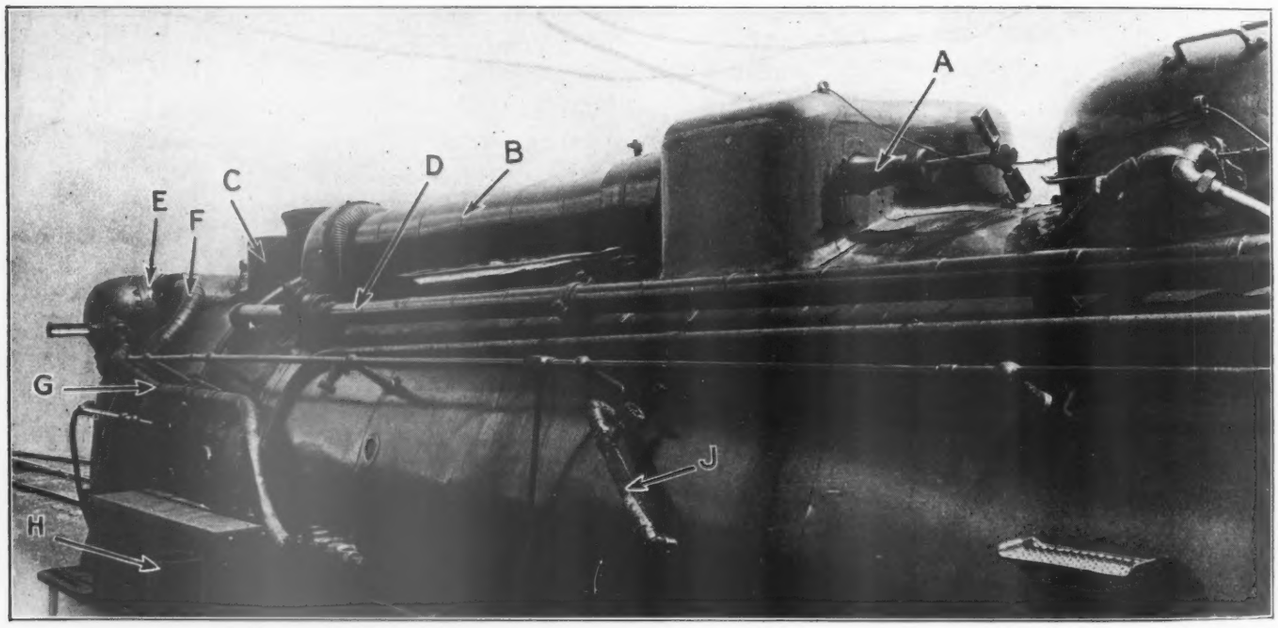
To insure that dry steam is delivered to the superheater, a steam separator is placed at the highest point in the dome. Any entrained moisture is removed from the steam before it enters the dry pipe and is returned to the boiler.

New Throttle Arrangement

The throttle valve, instead of being located in the dome, is placed in the top of the smokebox just ahead of the stack, shutting off the steam from the cylinders but not from the superheater. On account of this arrangement an outside dry pipe with a shut-off valve as clearly shown below, is used so that the steam can be shut off and the throttle ground without blowing down the steam pressure on the boiler. To reduce the number of joints, the dome and the back end of the dry pipe are made integral of a steel casting.

The steam after flowing through the dry pipe and superheater tubes, passes to the right side of the superheater header, which has a main outlet leading to the throttle which supplies the main cylinders and the booster and a smaller connection to the superheated steam pipe to the turret which supplies the other auxiliaries. The throttle valve is located at the top of the smokebox where it is readily accessible. It is of the usual double-seated poppet type with top lift operated by outside rigging. The expansion of the boiler tends to change the setting of the throttle valve and to overcome this the Jones compensating arrangement has been applied.

The cylinders and valves are in accordance with the usual practice with the exception of the valve travel which has been increased to 8¾ in. by a special design of Baker valve gear controlled by the Franklin type D Precision power reverse gear. The booster, which adds 17.3 per cent to the starting tractive effort of the locomotive, is the latest design type C-1 using superheated steam. The exhaust steam from the booster is discharged out of the stack, thus creating additional draft and increasing the steaming capacity of the boiler at low speeds.



Forward End of Boiler from Left Side

A, Shut-off Valve; *B*, Outside Steam Pipe; *C*, Throttle; *D*, Superheated Steam Pipe to Turret; *E*, Feedwater Heater; *F*, Exhaust Steam Pipe to Heater; *G*, Feedwater Discharge Pipe from Heater; *H*, Feedwater Pump; *J*, Drain Pipe from Steam Separator.

The feedwater heater is carried on brackets secured to a permanent top section of the smokebox front. This elevated location of the heater enables the water condensed from the exhaust steam to flow to the tender by gravity. The arrangement of the smokebox front avoids any difficulty in removing it to reach the front end netting or superheater.

Superheated Steam for Auxiliaries

Reference has already been made to the use of superheated steam in the auxiliaries. Special arrangements have been made so that if necessary, saturated steam can also be used. Two turrets are mounted over the firebox just ahead of the cab. The left-hand turret is connected to the superheated steam pipe leading back from the header and

carries transverse pipes leading to the right turret. The right turret has a connection to the saturated steam space in the boiler which is normally shut off. A stop valve is located in the superheated steam pipe to the turret just back of the point where it issues from the smokebox, so that by opening the valve between the right turret and the boiler and closing the valve in the steam pipe, saturated steam can be used. It is of interest to note that no changes in the design of the auxiliaries were necessary to adapt them for superheated steam, the only modifications being in the use of materials that would withstand the higher temperatures.

The tender has a capacity of 10,000 gal. of water and 16 tons of coal. It is carried on Commonwealth four-wheel trucks and has a Commonwealth cast-steel tender frame.

The accessories used on this locomotive include the Commonwealth-Franklin engine truck, type B Delta trailing truck with constant resistance centering device, Franklin radial buffer and unit safety drawbar, Pyle-National type K-2 headlight generator, Franklin grate shaker, Franklin adjustable wedge and driving box spreader and cellar, Franklin sprinkler and McLaughlin flexible joints.

The dimensions, weights and factors are as shown in the tabulated data sheet:

LOCOMOTIVE DATA SHEET

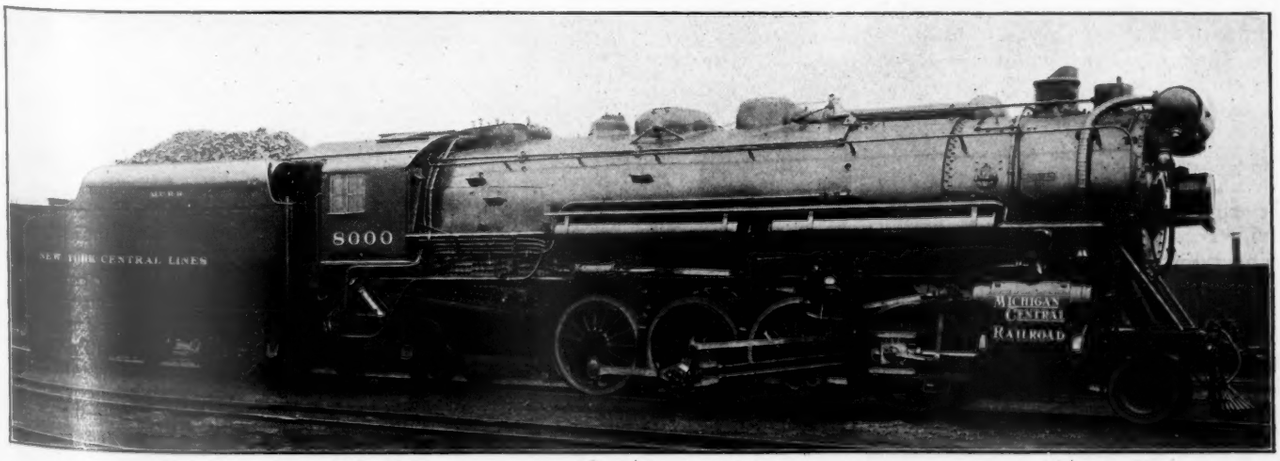
Railroad	Michigan Central
Type of locomotive	2-8-2
Service	Freight
Track gage	4 ft. 8½ in.
Cylinders, diameter and stroke	28 in. by 30 in.
Valve gear	Baker
Valves, kind and size	Piston, 14 in. dia.
Maximum travel	8¾ in.
Outside lap	1¼ in.
Exhaust clearance	1/8 in.
Lead in full gear	1/4 in.
Weights in working order:	
On drivers	245,500 lb.
On front truck	30,000 lb.
On trailing truck	58,500 lb.
Total engine	334,000 lb.
Tender	199,700 lb.
Wheel bases:	
Driving	16 ft. 6 in.
Rigid	16 ft. 6 in.
Total engine	37 ft. 0 in.
Total engine and tender	71 ft. 6½ in.
Wheels, diameter outside tires:	
Driving	63 in.
Front truck	33 in.
Trailing truck	45 in.
Journals, diameter and length:	
Driving, main	11½ in. by 14 in.
Driving, others	11 in. by 13 in.
Front truck	6½ in. by 12 in.
Trailing truck	9 in. by 14 in.
Boiler:	
Type	Straight top
Steam pressure	200 lb. per sq. in.
Fuel, kind and B.t.u.	Bituminous coal, 14,000 (app.)
Diameter, first ring, outside	86 in.
Firebox, length and width	114¼ in. by 84¼ in.
Height, grate to crown sheet, back	68½ in.
Height, grate to crown sheet, front	87 in.
Arch tubes, number and diameter	8—3½ in.
Combustion chamber	None
Tubes, number and diameter	253—3¼ in.
Tubes, length	20 ft. 0 in.
Tubes, spacing	5/8 in.
Tubes, inside diameter	2,982 in
Gas area through tubes	12.26 sq. ft.
Net gas area through tubes	9.47 sq. ft.
Grate type	Table
Grate area	66.4 sq. ft.
Heating surfaces:	
Firebox, incl. arch tubes	291 sq. ft.
Tubes	4,287 sq. ft.
Total evaporative	4,578 sq. ft.
Superheating	1,780 sq. ft.
Comb. evaporative and superheating	6,358 sq. ft.
Tender:	
Style	Rectangular
Water capacity	10,000 gal.
Fuel capacity	16 tons
Special equipment:	
Brick arch	American Arch Co., double arch
Superheaters	Superheater Co., Type B
Feedwater heaters	Superheater Co.
Stokers	Elvin Mech. Stoker Co.
Booster	Franklin Ry. Supply Co.
General data, estimated:	
Rated tractive force, 85 per cent	63,500 lb.; with booster 74,500 lb.
Cylinder horsepower (Cole)	2,824
Boiler horsepower (Ccle) (est.)	2,735
Speed at 1,000 ft. piston speed	37.5 m.p.h.
Steam required per hour	58,700 lb.
Boiler, evaporative capacity per hour	56,900 lb.
Coal required per hour, total	9,180 lb.
Coal, rate per sq. ft. grate per hour	138 lb.
Weight proportions:	
Weight on drivers ÷ tractive force	3.86
Weight on drivers ÷ total weight engine	.735
Total weight engine ÷ cylinder horsepower	118
Total weight engine ÷ boiler horsepower	122
Weight per sq. ft. of combined heating surface, lb.	52.5
Boiler proportions:	
Boiler horsepower ÷ cylinder horsepower	96.9 per cent
Comb. heating surface ÷ cylinder horsepower	2.25
Tractive force ÷ comb. heating surface	9.99
Tractive force × dia. drivers ÷ comb. heating surface	630
Cylinder horsepower ÷ grate area	42.5
Cylinder horsepower ÷ net gas area of tubes in sq. ft.	298
Firebox heating surface ÷ grate area	4.38
Firebox heating surface ÷ evap. heating surface	6.36 per cent
Superheating surface ÷ evap. heating surface	38.9 per cent
Tube length ÷ inside diameter	80.5

Engine No. 8000 has been in operation since about the first of June between Detroit and Toledo, and between Toledo and Jackson, Mich. The Michigan Central Railway is preparing to make exhaustive tests of the engine, data from which will be available at a later date. So far the engine has exceeded the expectation of the builders, both in developing high drawbar pull and in economy of operation.

On June 24, 9,254 tons in 138 cars were hauled from Detroit to Toledo, without help, a distance of 47.6 miles in 3 hr. 31 min., no trouble being experienced in starting this train with booster in operation; in fact, for the first 10 miles the tonnage was 9,394 tons in 140 cars, 2 cars being set off on account of hot boxes. On June 30, 10,039 tons were hauled over this division in 147 cars, no assistance being required to start or haul this train.

No trouble has been experienced in maintaining full boiler pressure when operating at maximum capacity.

The evaporation per pound of fuel is phenomenal, as for three of the full tonnage runs made between Detroit and Toledo, the total water divided by total fuel averaged 9.7 lb. which indicates a combined efficiency for the boiler and superheater of about 77 per cent.



Right Side of the Locomotive, Showing Removable Plate Over Superheater Header and Outside Throttle Rigging

Nick-Bend Test for Wrought Iron*

THE material examined represents the finished product of four different manufacturers and an intermediate stage in wrought-iron manufacture from a fifth source, nine grades in all being tested.

The methods used for fracturing the nicked bars varied from a slowly applied transverse bending stress to a severe single-blow impact stress. This range is permitted by most current American specifications. Although the investigation has not been comprehensive enough to furnish answers to all the questions which may arise concerning the nick-bend test for wrought iron, the results obtained are definite enough to permit certain conclusions being drawn and to warrant certain recommendations concerning the test.

1. The rate of application of the stress used in rupturing the bars appears to be one of the most important factors which affect the results of the test, that is, the appearance of the fracture. All of the grades tested successfully passed inspection when slowly or moderately stressed. Under shock, however, all showed crystallinity in the fracture, several to an extent which would cause rejection. The results obtained suggest the desirability for defining more strictly the conditions for carrying out this test than is the case in many current specifications. The ordinary methods used in mechanical testing fail almost entirely to give an indication of the features shown by the nick-bend test.

2. The appearance of the fractures of nicked bars broken by impact is dependent upon the character, particularly the extent, of the notch to a very marked degree. The depth and length of the notch relative to the specimen tested should be carefully regulated. This can be more readily done by notching in the press with a special chisel than by hand. Specimens having complete circumferential notches, when broken by severe impact, showed very little crystallinity, whereas the same material notched on one side only often showed very large crystallin patches.

3. There are two distinct types of crystallin areas produced in the nick-bend test of wrought iron. The one near the tension side of the stressed bar is the direct result of the stress applied and indicates certain characteristics of the material. The crystallin area on the compression side, which is often the larger and more conspicuous of the two, depends for its formation upon the preliminary permanent distortion in compression of the crystals in this part of the specimen, and does not necessarily indicate any characteristic features of the unstressed material.

4. Prominent steel-bearing streaks in wrought iron appear to favor to some extent the formation of crystallin areas when fractured under impact, although crystallin areas are not necessarily indicative of steel in the iron. Prominent slag streaks often permit longitudinal separations to occur during testing, thus giving rise to a fibrous appearance. The absence of such streaks or the presence of small and uniformly disturbed streaks appears to favor the production of larger crystallin areas upon impact.

5. In the testing of plates or flat bars by the nick-bend test the relation of the location of the notch with respect to the slag plates ought to be specified, that is, whether upon the edge or the flat side of the plate.

6. Bars which had been permanently stretched before being subjected to the nick-bend test gave no indications so far as the characteristic features of the fracture were concerned of the preliminary treatment to which they had been subjected. The cold work very materially strengthened such bars, however, so that a much severer blow was necessary in the fracturing of such specimens than before stretching.

7. The present investigation was carried out upon bars of uniform size, 1 in. in diameter. An additional study of other sizes, preferably larger ones, would undoubtedly throw further light upon the results of the nick bend test and their interpretation. Likewise the testing of bars of abnormal composition, particularly irons high in phosphorus, would give results of value regarding this test. Variations in the method of gripping the specimen, relative to the notch, may also merit some attention. The present study gives no information on these points.

* Summary and conclusions of a paper entitled "Some Observations on the Nick-Bend Test for Wrought Iron," presented by Henry S. Rawdon and Samuel Epstein of the U. S. Bureau of Standards at the 1922 annual meeting of the American Society for Testing Materials.

Report on Fuel Accounting*

The committee concurred in the recommendation of the Purchases and Stores Division of the American Railway Association that locomotive fuel be accounted for by individual locomotives, both as to quantity and value chargeable to each account by divisions, main and branch line districts, freight and passenger service and by states, for yard switching service; also, a charge for quantity and value by accounts for all fuel used for miscellaneous purposes, and submitted the following conclusions on the three points carried over from the 1921 meeting:

1. Other than locomotive fuel; 2, coal picked up in yards and on right of way, and 3, coal removed from overloaded commercial cars.

1. Fuel used for all purposes other than locomotive operation, such as stations, elevators, power plants, etc., should be charged out to the facility and in the month in which it is used. Fuel ticket and department invoice, properly receipted, should be required to cover the issue.

2. Coal picked up in yards and on right of way and fuel oil reclaimed in sump should be charged to the service in which it is used and locomotive fuel account credited, as it is the clearing house for all such over and under charges.

The labor cost of recovering such fuel should be charged as follows:

(a) "Roadway Maintenance" ("General Cleaning") if outside of shop yards and used for other than locomotive operation, or recovered in hump or classification yards.

(b) "Shop Expenses" if within shop yards and used for other than locomotive purposes.

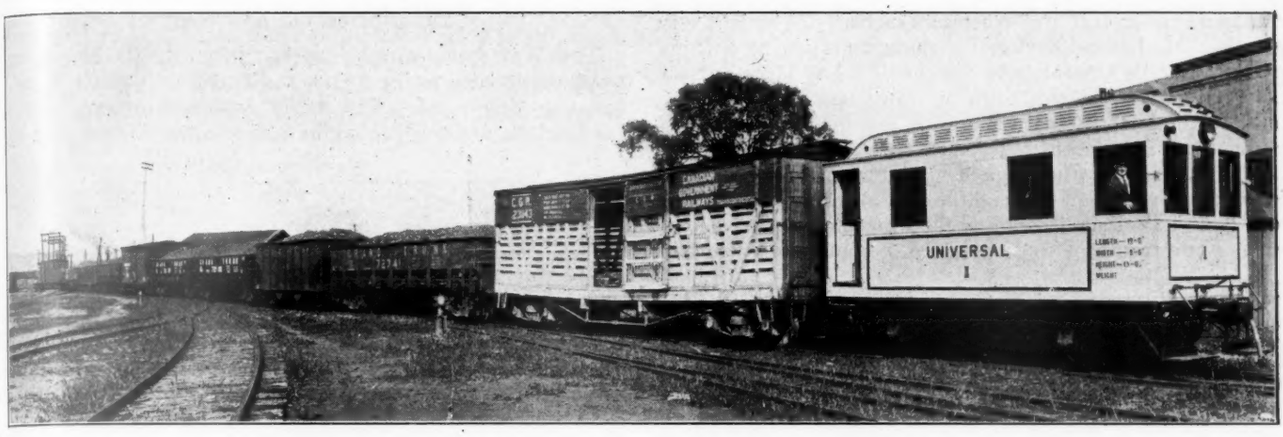
(c) "Fuel Station Operation" if such fuel, after being recovered, is used on locomotives.

3. The overload removed from commercial cars may be used by the company for its own operations, and payment made to the shipper for the actual amount of coal removed at a price agreed upon, with deduction covering cost of labor, switching and reweighing. Where car is returned to mine from scale for lightening by the shipper a switching charge should be assessed.

The report was signed by J. N. Clark, chairman (Sou. Pac.); C. N. Beyerly (B. & O.), E. E. Chapman (A. T. & S. F.), R. R. Hibben (M. K. & T.), R. E. Jones (D. & I. R.), Joseph McCabe (N. Y., N. H. & H.), Hugh McVeagh (Big Four), C. F. Needham (Grand Trunk), and W. J. Tapp (D. & R. G. W.).

*Abstract of report to International Railway Fuel Association convention, Chicago, May, 1922.

ECONOMIC ASPECT OF POOR VISION.—In the examination of more than 10,000 employees in factories and commercial houses, 53 per cent were found with uncorrected faulty vision and 13 per cent had defects which were corrected, making a total of 66 per cent with defective eyes. This is the summary of a report of studies made by the Eye Sight Conservation Council of America, headquarters Times building, New York city. In one manufacturing establishment over 70 per cent were found with eye defects. As an example of inefficiency and resulting waste, 20 per cent of the inspectors in a large factory were found to be unable to see sufficiently well to detect defects in the product they were inspecting. More attention has been given to the perfecting of machinery than to the correcting of physical defects in the workman. Every manager should see to it that the eyes of all associated with him are corrected to compensate for defects. It will pay from a purely business standpoint.

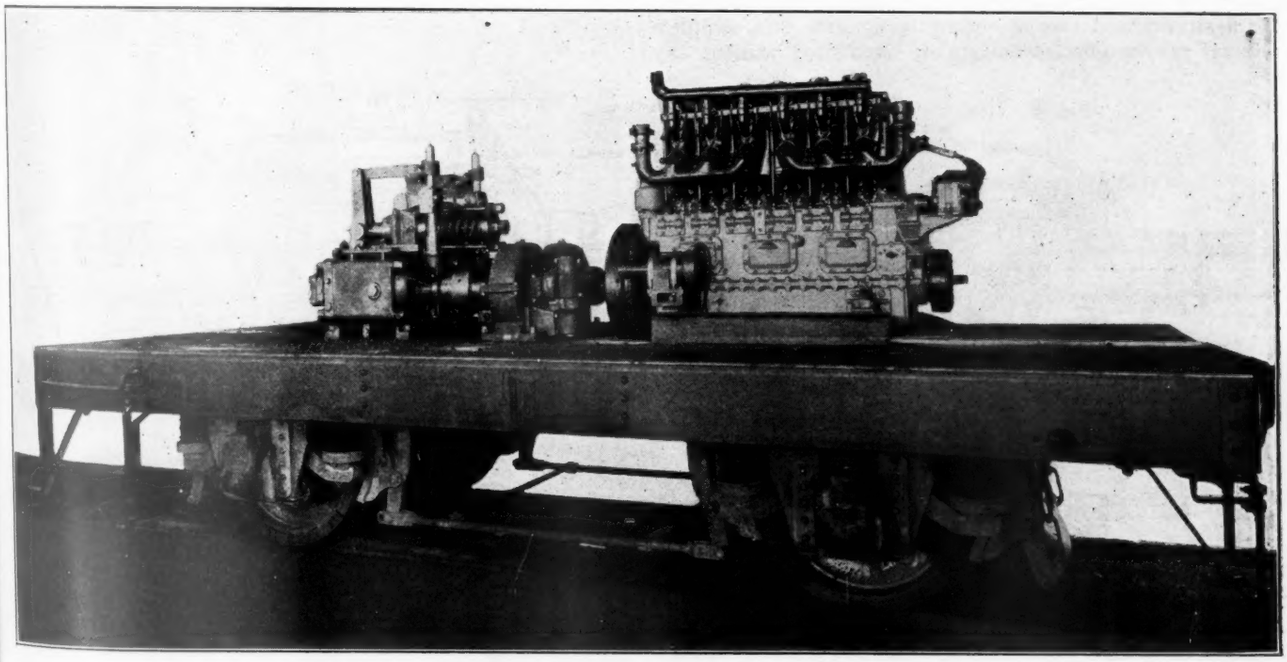


Hauling 14 Cars Weighing 645 Tons with a 150-Horse Power Gasoline Locomotive

Gasoline Switching Locomotive with Hydraulic Drive

Universal Oil Transmission Governs Speed and Direction and Gives Remarkable Flexibility of Control

ONE of the most promising developments in the application of the internal combustion engine for railroad motive power is a gasoline switching locomotive designed by John Robson, chief engineer of The Universal Engineering Corporation, Montreal, Can., and recently built under his supervision at the plant of the Canadian Car & Foundry Company, Montreal. The most notable feature of the equipment is the arrangement of power transmission and speed control. This is effected by a Waterbury hydraulic variable speed gear, built in this country by the Waterbury Tool Company, Waterbury, Conn., which gives any speed from zero to the maximum in either direction without steps or gradations and without varying the speed or direction of rotation of the engine. The power to drive the locomotive is supplied by a 150-hp., six-cylinder Ricardo gasoline engine, the engine and transmission being arranged to give a maximum tractive effort of 12,000 lb. and a maximum speed of 12 miles an hour. The locomotive is intended for switching service and has two independently driven axles. It is 19 ft. long and weighs 53,000 lb.



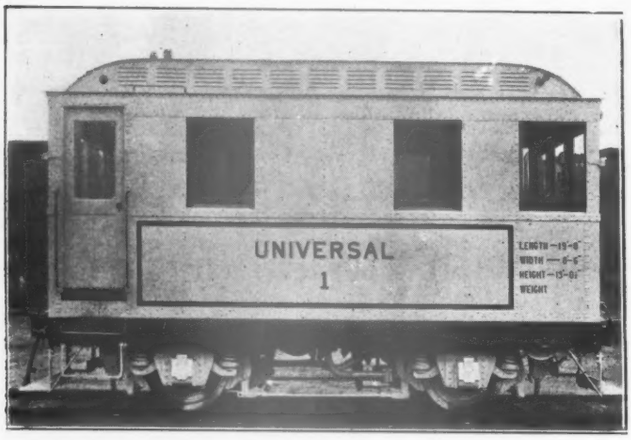
Locomotive with Power Plant and Transmission in Place, Before Cab Has Been Applied

Advantages of Hydraulic Transmission

In practically every design of railroad equipment using internal combustion engines built heretofore, the transmission of power has been effected by shifting gears and clutches, or by electric generators and motors. Neither of these methods is entirely satisfactory. While gasoline-electric equipment affords the necessary flexibility, the control is compli-

cated and the motors and generators increase the weight very greatly. Mechanical devices for changing speed by shifting gears cannot be satisfactorily designed for any large number of speed ratios and this form of transmission can be used only for small size engines due to the limited amount of power that can be transmitted through a friction clutch.

The hydraulic variable speed gear used in this locomotive is comparatively light in weight, easily and simply controlled and gives any desired speed of the locomotive while the engine is governed at a constant speed. Control of speed and

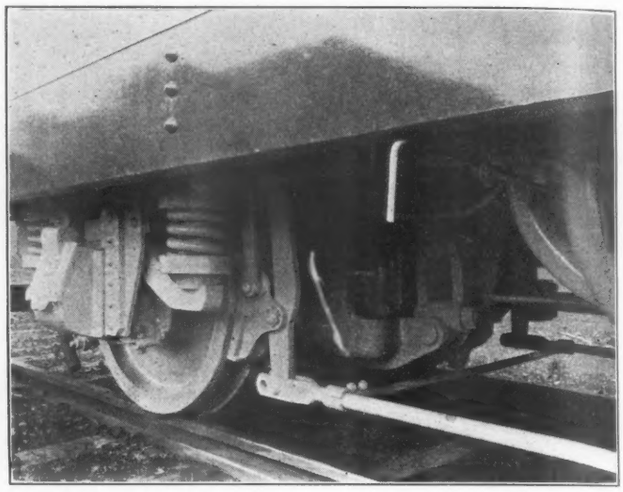


In Appearance the Locomotive Resembles a Small Electric Car

direction can be effected with a minimum of effort on the part of the operator regardless of the load on the locomotive, the flexibility and ease of control being such that complete reversal can be effected as quickly as desired without any undue peak load on the engine, thereby avoiding excessive stresses in the working parts. By the use of an automatic pressure control device the speed of the locomotive is regulated by the drawbar pull entirely independently of the operator in such a manner as to prevent overloading and possible stoppage of the engine owing to stalling.

Description of the Gear

The Waterbury variable speed gear consists of an oil pump, designated as the A-end, and a hydraulic motor, designated as the B-end. The A-end, which is driven by the gasoline engine, delivers oil to and receives it from the B-end, the direction of flow and the amount of oil being controlled by a regulating device. The B-end rotates at any speed up to that of the A-end and in either direction, depending upon the quantity and direction of delivery of the oil it receives from the A-end.



A View Under the Body Showing Hydraulic Drive and Suspension

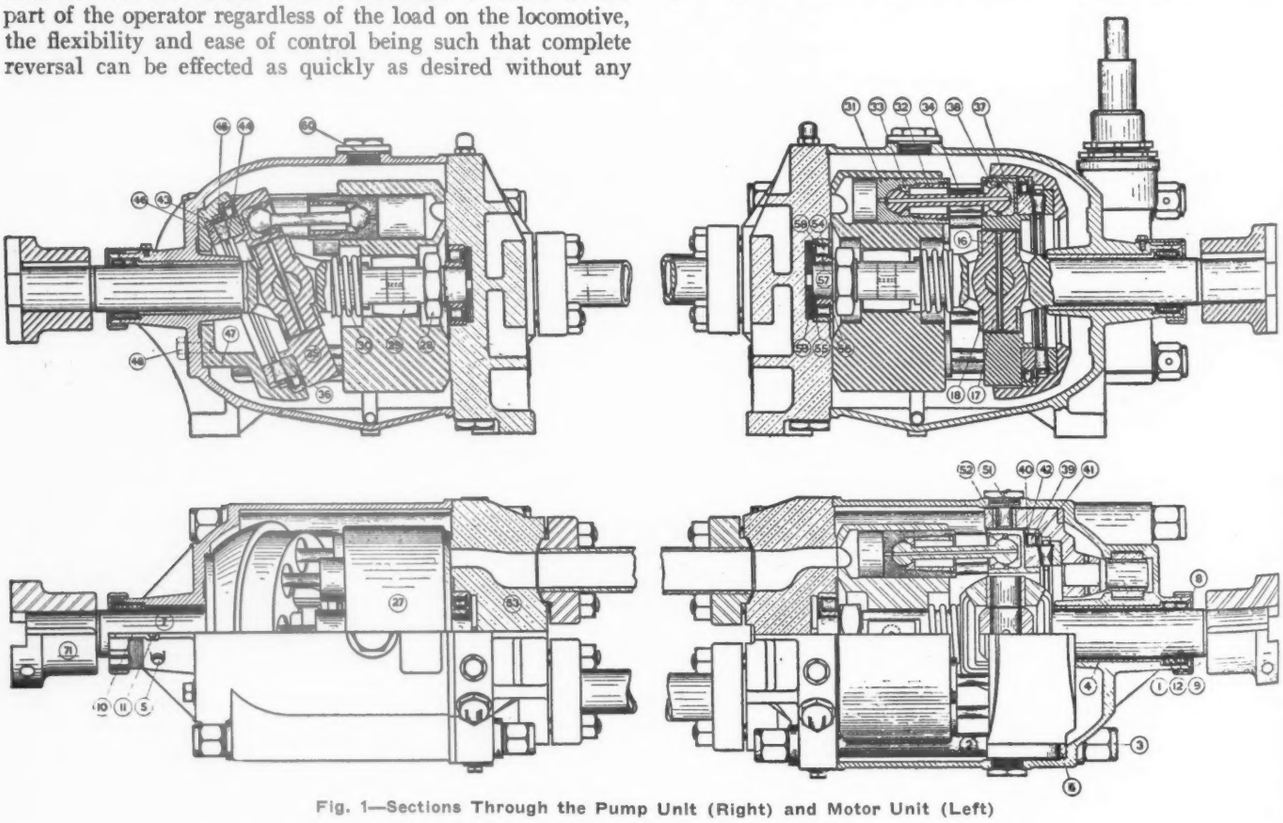


Fig. 1—Sections Through the Pump Unit (Right) and Motor Unit (Left)

The construction and operation of the gear can readily be understood by referring to Fig. 1. In this drawing the driven shaft of the A-end, which receives the power from the gasoline engine, is shown at the extreme right hand side while

the driving shaft of the B-end is at the extreme left. A cylinder barrel (27) is keyed to the inner end of each shaft. Each barrel has nine cylinders parallel to the shaft and fitted with pistons. When the barrels revolve, their inner faces slide on the valve plates (53), each of which has two ports, the ports in the A-end being connected to those in the B-end by the shaft their planes of revolution may be at any angle with the shaft provided by the setting of the roller bearings on which the socket rings revolve.

In the B-end of the gear the socket ring runs in an angle box secured in the end of the case and making a fixed angle of 20 deg. with the shaft. Thus as the shaft, the barrel and

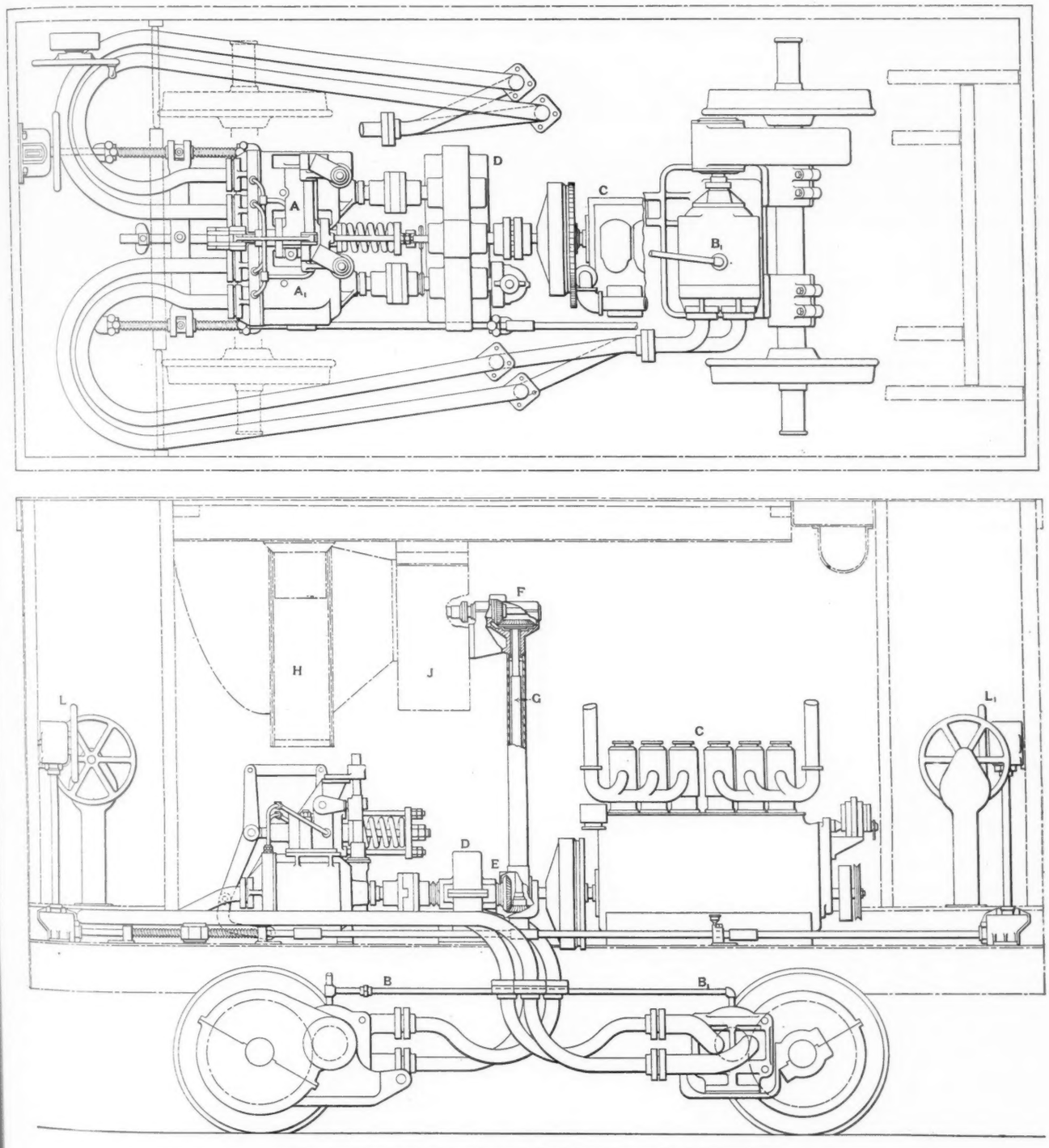


Fig. 2—Plan and Elevation of Gasoline-Hydraulic Locomotive

piping. The cylinder ports in the barrel faces register with semi-annular passages or ports in the valve plates, except at the bridges at the top and bottom of the plates. The connecting rods have one end secured in the piston and the other in the socket ring (35). The socket rings are connected by universal joints with the shaft so that while they revolve with socket ring revolve in the B-end, the pistons will have a reciprocating motion with a constant stroke. In the A-end the angle box is hung on trunnions and may be adjusted to any desired angle while the gear is running by means of the control shaft. If the angle box in the A-end stands in the neutral position at right angles to the shaft, the pistons are

carried around with the cylinder barrels but have no reciprocating motion. No oil is therefore taken from or delivered to the passages in the valve plates. If the tilting box is inclined by moving the control shaft, the pistons begin to reciprocate, the stroke depending on the angle between the socket ring and the axis of the shaft. Every cylinder during one half of the shaft's rotation is drawing in oil from one of the passages in the valve plate which it carries over and delivers into the other passage during the next half of the shaft's rotation.

The oil from the A-end is forced into one of the passages of the valve plate of the B-end. The cylinders of the B-barrel in communication with this passage make room for the oil by sliding back from the valve plate, but they cannot do this without forcing their respective sockets in the socket rings farther from the valve plates. This can only be done by turning the socket ring as a whole in its inclined plane in the angle box. While the pistons facing the pressure passage

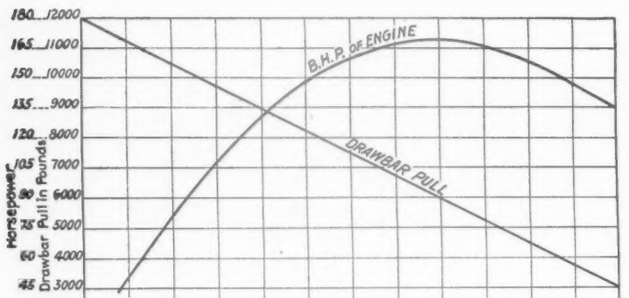


Fig. 3—Drawbar Pull and Brake Horsepower Curves

of the B-valve-plate are receding to make room for the incoming oil and so imparting rotation to the B-shaft, the pistons facing the no-pressure passage are moving toward the valve plate and delivering oil into the respective cylinders of the A-barrel. Since the receiving capacity of the B-cylinders is constant and the delivery capacity of the A-cylinders is varied at will by turning the control shaft, the speed of the B-shaft is correspondingly varied. With the engine running at constant speed the speed of the B-end depends upon the angle which the socket ring in the A-end makes with the shaft, while the direction in which the B-end revolves is governed by the direction in which the socket ring in the A-end is moved from the neutral position.

The efficiency of this type of transmission is high, ranging from 68 per cent at 25 per cent of normal speed to 82 per cent at full speed. The combined A- and B-ends weigh less than 25 lb. per horsepower transmitted. The pressures on the sliding surfaces are largely balanced so that little wear takes place and the pistons have long bearings in the barrel. In spite of the high pressures carried, leakage is negligible.

The appearance of the completed locomotive and the arrangement of the engine and hydraulic speed gear are clearly shown in the photographs. The operation will be readily understood by reference to the plan and elevation drawings.

The power for the locomotive is obtained from a six-cylinder Ricardo gasoline engine *C* with pistons of 5⅝ in. diameter and 7½ in. stroke, capable of delivering 150 brake horsepower when running at a normal speed of 1200 r.p.m. This engine drives through a double-helical reduction gear *D*, two size 50 pump units, *A* and *A*1, at 345 r.p.m. From the valve plates of these pump units, piping conveys the oil which is used as a transmission medium to two size 50 speed gear motor units, *B* and *B*1, each of which is connected by spur gearing to one of the driving axles of the locomotive. The casings of the speed gears are connected by piping to a common oil reservoir placed in a convenient position on one of the bulkheads of the engine room, the oil in this reservoir being subject to atmospheric pressure only. Flexible couplings are used between the gasoline engine and the reduction gears as well as between these gears and the pump units of the speed gear in order to allow for any vibration or springing on the framing of the locomotive.

The engine is cooled in the ordinary manner by means of a tubular radiator and fan, the latter being driven from an extension of one of the reduction gear shafts through bevel gears, *E*, *F*, and the vertical shaft *G*, the radiator *H*, and fan *J*, being suspended from the roof of the locomotive, where both the inlet and outlet passages for the fan are provided. The motor units, *B* and *B*1, of the Waterbury speed gear, together with the housing for the spur reduction gear between these units and the axles, are carried on cradles with link and swivel suspension to the under side of the frame-work, as clearly shown in one of the photographs. In this way vertical movement of the axles is provided for without interference with the gearing.

The control of speed and direction is effected by means of either of two hand wheels, *L* and *L*1, placed in the driving compartment at each end, one man only being required to operate and control the locomotive, the speed of which is governed automatically by a hydraulically operated control gear, which acts independently on the control shafts of the pump units as soon as the drawbar pull exceeds a predetermined amount. By the action of a plunger and spring, the stroke on the pistons is regulated in inverse ratio to the oil pressure and in consequence it is not possible for the operator to overload the engine. The pressure range through which the control is designed to act, is from 300 lb. up to 1,200 lb. per square inch, so that on very short piston strokes a torque of approximately four times the normal can be obtained on the axles of the locomotive.

Hand operated brakes of standard pattern are provided and work by a hand wheel placed in each compartment, these brakes being used only for emergency purposes as the stopping and starting, as well as acceleration and deceleration are controlled entirely through the speed gears. For use in coupling the locomotive with freight cars, standard air connections and cylinders are provided for operation in the usual manner from the driving locomotive.

The curve illustrated in Fig. 3 shows the relation between drawbar pull and speed up to 12 miles an hour with the control hand-wheel set for full stroke on the pump units of the hydraulic speed gear, the actual stroke, speed and horsepower of the engine being regulated by the automatic adjustment of the pressure control piston.

In actual service the locomotive has shown remarkable flexibility, which is particularly advantageous in switching service where high starting tractive effort and rapid acceleration are required. The locomotive may be started under a dead load of any amount without overloading the engine. Three turns of the hand-wheel from the neutral position will bring the locomotive up to its full speed. In stopping, the locomotive is gradually brought to a standstill by turning the control shaft to neutral, and in this position the B-end is positively locked against motion in either direction.

Several trials have been made at the plant of the Canadian Car & Foundry Company which have been entirely satisfactory. The locomotive exerts a tractive effort of 12,000 lb. at starting and 3,000 lb. at 12½ miles an hour. On level track a load of 645 tons has been handled readily. In one trial the locomotive took three cars weighing 150 tons up a four per cent grade, stopping at the steepest point and starting again under full load without difficulty. The Universal Engineering Corporation intends to apply the variable speed hydraulic gear to a locomotive of similar type designed for passenger service and also to high-capacity passenger cars.

Paint Reports to the A. S. T. M.

TWO reports on the subject of paints and protective coatings which were submitted at the annual convention of the American Society of Testing Materials held at Atlantic City, N. J., June 26-30, were of considerable general interest. Neither of these reports can be considered as final but they indicate the direction in which future progress will probably be made, as will be noticed from the following short abstracts.

Some Physical Properties of Paints

This report was submitted by P. H. Walker, chemist, and J. G. Thompson, assistant chemist of the U. S. Bureau of Standards. In introducing the subject attention was called to the fact that the life of any paint may be divided into three periods: (1) the period of storage between manufacture and application, (2) the period of application when the paint is spread out in a thin, wet film, and (3) the period of exposure covering the life of the dry paint film. Each period is characterized by certain physical properties which indicate the value of the paint. During the first period little information of value is obtainable, but certain defects in manufacture or material may be indicated by such phenomena as flocculation, caking, or excessive settling. It is during the second period that the really valuable physical properties, such as the wetting power or adherence to the surface, ease of application, hiding power, color, uniformity, gloss, spreading rate, and rate of drying appear. In the final stage of the life of the paint the only factors considered are those which affect the permanence or stability of the film established as a result of the properties which appear and function during the second period. All of these properties are important, but few if any can be measured with any degree of accuracy, and most of the properties are tested by methods in which the personal equation is so large that reproducible results can not be obtained. Any study of the physical properties of paints necessarily must begin with a standardization of tests.

The Preparation of Paint Films. In view of the number and importance of the properties which first become evident at the time of application, it is obvious that this forms the logical starting point for any investigation. The physical properties which combine to determine the consistency or behavior of a paint at the time of application are of fundamental importance, but before any comparative study could be undertaken it was necessary to devise some reproducible method of preparing paint films. Flowing produces satisfactory results but unfortunately is limited to a few of the thinnest paints. The ordinary methods of brushing and spraying are unsatisfactory since the resulting films are never uniform and can be duplicated only by accident. Some mechanical means therefore must be employed and as a result of some promising preliminary experiments centrifugal force was adopted.

A number of circular glass plates furnished the standard surfaces to be covered with paint. These plates were each 25 cm. in diameter and approximately 1 cm. thick. The surfaces were ground flat and finished by fine grinding but were left unpolished, to furnish a surface to which the paints would adhere readily. In the earlier work steel plates were used but were later discarded, as the glass proved to be much easier to handle and to keep clean.

The apparatus employed consists of a vertical spindle rotated by a belt connected with a variable speed motor. To the upper end of the spindle is fastened a circular wooden block to support the glass plate. The plate is brought up to constant speed and an excess of paint, previously screened through a 200-mesh sieve to insure uniformity and freedom from skins, is poured on at the center of the plate. The paint flows out, covers the surface, and the excess is thrown off. The motor is then stopped and the plate removed and allowed to dry. After the paint is dry the film thickness is determined by means of an Ames dial gage, reading direct to 0.01 mm. and estimating to 0.001 mm.

At any given speed, the centrifugal force increases directly with the distance from the center of rotation. One would expect, therefore, that the resulting film would be thinnest at the circumference of the plate and would reach a maximum at the center. This is what usually occurs and the resulting film is generally pyramidal, although the pyramid does not extend uniformly over the entire surface. The film usually presents the appearance of a large, flat plane with a small, sharply defined pyramid at the center. The pyramidal film which is characteristic of most paint is not produced by varnishes nor by liquids such as linseed oil. These give flat films of uniform thickness across the entire surface, in spite of the fact that the centrifugal force varies widely at different points on the plate. A table accompanying the paper gave the film thickness measured at varying distances from the center. Raw linseed oil gave a film about 0.016 mm. thick, varnishes 0.024 mm. to 0.040 mm., enamels and oil paints 0.030 mm. to 0.085 mm.

Numerous experiments with varying amounts of paint led to the conclusion that the film thickness is independent of the amount of paint applied. An insufficient amount will cover only a portion of the surface while an excess will cover the entire surface and the excess be thrown off. The resulting films in both cases are of equal thickness at corresponding points, but for the sake of convenience it is advisable to use a slight excess to insure covering the entire surface.

At speeds of 200 r.p.m. or less many paints produce films too thick to dry properly. Too high speeds cause segregation of the pigment particles and in some extreme cases a tendency to disrupt the film has appeared. A speed of 300 r.p.m. seems to be the most generally satisfactory.

The film thickness is practically independent of the time of whirling after the first short interval of time has elapsed. Working with ordinary paints at a speed of 300 r.p.m., it was found that three minutes' whirling invariably provided a comfortable margin of safety beyond the time necessary to reach equilibrium.

The most satisfactory features of this method are the uniformity of the films produced and the ease and certainty with which they can be duplicated.

The Effect of Varying Composition on Paint Films. The next investigation was a study of the effect produced upon the life and behavior of a paint film by varying the proportions of pigment and oil in the film. For comparative purposes the films should be of equal thickness and the use of centrifugal force as previously described furnishes a convenient means for determining the film thickness which will result when any paint is spread under certain selected conditions. If several paints produce films of equal thickness when whirled at the same speed it may be assumed that those paints will produce comparable films when brushed out on test panels. The object sought was to produce a series of paints of varying oil-pigment ratios thinned with turpentine until they would spread or brush out to produce dry films of equal thickness.

Four pigments were selected for study:

(a) Basic carbonate white lead;
(b) Zinc oxide;
(c) 60 per cent basic carbonate white lead, 40 per cent zinc oxide;
(d) 60 per cent basic carbonate white lead, 30 per cent zinc oxide, 10 per cent asbestine.

Each pigment was ground to a paste with a normal amount of raw linseed oil. Each paste was divided into several weighed portions and varying amounts of oil were added to the different portions until the resulting series of semi-pastes

or semi-paints represented a range of pigment content varying from 15 to 50 per cent by volume, the corresponding limits for the oil being 85 and 50 per cent by volume. Liquid drier was added to each semi-paint in the proportion of 5 cc. of drier to 95 cc. of oil.

Some one mixture had to be chosen as an arbitrary standard and that consisting of 25 per cent basic white lead and 75 per cent oil was adopted, since this mixture behaved well under the brush and produced a film of satisfactory appearance and properties. The other mixtures were thinned with turpentine until they produced the same film thickness when whirled at the same speed. The turpentine being volatile serves merely to increase temporarily the mobility of the paints and later evaporates.

The preparation of the paints resulted in some interesting observations. As expected, it was found that the thinning power of turpentine varies with the different pigments, but it was rather surprising to find a variable thinning power for any one pigment depending upon the composition of the vehicle already present, as appeared in the cases of the zinc oxide and mixed pigments. It is difficult to draw conclusions regarding the consistency of the paints from the data, since the thickness of the wet films will vary widely although the dry films are all of equal thickness. Nevertheless there is unmistakable evidence that the thinning power of turpentine not only varies with different pigments but also varies for any one pigment with the composition of the mixture being thinned.

Causes of Spotting with White Lead Paints. It is generally believed that a paint resulting from the thinning or breaking up of a basic carbonate white lead paste should be allowed to stand for a day or two before being used. The probable reason for the origin of this belief was found when a white lead-oil-turpentine paint was used immediately after mixing, flowing the paint on a clean glass plate to form a smooth wet film, in the course of a few minutes small pits appeared on the surface of the film and gradually increased in depth and diameter. The phenomenon appeared over and over and could not be ascribed to any fault in the preparation of the surfaces painted. The same result was obtained no matter whether the paint was applied to glass, steel, or to a previously dried coat of paint.

Summarizing the results of many experiments it appears that the spotting tendency:

(a) Is common to all mixtures of basic carbonate white lead and raw linseed oil;

(b) Does not appear when other pigments are substituted for the basic carbonate white lead;

(c) Does not appear when other oils are substituted for raw linseed oil;

(d) Is not due to too much stirring or to lack of stirring; presence or absence of liquid driers and volatile thinners; order of mixing; presence of free fatty acids, mineral acids, or water, although any or all of the foregoing factors may at times exert a modifying influence;

(e) May be explained upon the assumption of a reaction between the basic carbonate white lead and some unidentified portion of the oil;

(f) May be eliminated by boiling the oil in the presence of driers which may convert the troublesome component to an inactive form; by treating the raw oil with basic carbonate white lead during storage prior to its use; or by aging the paint to allow the reaction to reach completion before the paint is applied.

Accelerated Weathering of Paints

This report was submitted by Harley A. Nelson as a contribution from the research laboratory of the New Jersey Zinc Company.

The most universal weathering cycle responsible for the deterioration of exposed surfaces is light, moisture, and temperature variations. Other weathering agents, such as wind and abrasive dust, are more localized. This paper describes an effort to reproduce directly on typical surfaces, not only changes in some one physical property, but all of the more common paint failures that are observed on painted wood and metal structures. With this objective, it has been necessary to study and develop the most available artificial sources for light, moisture and temperature variations.

The apparatus used consisted of a wooden exposure tank, 6 ft. diameter and 4 ft. 9 in. high with an insulating air space and a galvanized iron lining. The cover is provided with an opening, which received a removable collar supporting a vertical quartz mercury arc of 30-in. effective lighting length. The test panels are supported by zinc nails on removable racks provided with sheet-zinc water drains. Water simulating a beating rain is provided by a revolving spray, and fine fog or mist by an atomizer. An ordinary variable-speed electric fan serves to cool the mercury arc and maintain a uniform temperature.

Any accelerated test on paints depends on radiation in the ultra-violet region of the spectrum. The most active rays have a wave length of about 3,000 Angstrom units. The mercury arc adopted as a source of light is used on 220-240 volts D. C. and normally draws 6 to 7 amperes when the atmosphere within the tank is kept at about 60 deg. C. (140 deg. F.) which is taken as representing summer heat.

Exposures are made at 28 in. from the light source. The panels are of selected white pine, or standard grade steel, 6 by 12 in., painted according to approved practice. An exposure tank of the size used will hold 75 panels. For warm seasons, the cycle most used has been: Light 24 hours (temperature 50 deg. to 60 deg. C.), cooling, followed by moisture 24 hours (temperature 5 deg. to 10 deg. C.). During cold weather 24-hour outdoor exposures have been added. Exposures have usually extended for periods of 60 to 90 days, with daily inspections.

Tests were made of paints containing various pigments, including zinc oxide, basic carbonated white lead, Lithopone, Titanox together with various mixtures.

Loss of gloss and formation of removable "chalk" follow in the order that these develop under normal outdoor exposure. Saturation of the film accelerates chalking under the ultra-violet light. "Checking," developing gradually into deep cracking and fine scaling, has not been reproduced. Cracking has been reproduced to a limited extent by periodic exposures to low temperatures. Lack of adherence is evidenced by blistering and peeling when the saturated panels are exposed to the heat of the quartz mercury arc (50 to 60 deg. C.).

The relative susceptibilities of paints containing Lithopone to light darkening and the relative tendencies of tinted or colored paints to fade and discolor under light and moisture, are revealed by exposure.

The test has been applied to paints applied on metal surfaces with as encouraging results as were obtained from painted boards.

While there are at present limitations which must be recognized there is apparently a general need for accelerated tests which will give the effects in a day which take a month under actual outdoor weathering.

The French Railways are, under a Ministerial decree, being equipped with cab signals whereby a whistle is blown when an engine passes over a ramp—called a crocodile—in the "four-foot" should the distant signal be at "danger." This is not automatic train control, as the brake is not interferred with. From a statement made recently by M. le Trocque, the Minister of Public Works, this work will very shortly be completed. He also said that all passenger carriages will soon be lighted by electricity.

Report on Firing Practice*

Mechanical firing on locomotives, like hand-firing, is subject to careless and extravagant practices. Correct supervision is as necessary here as in hand-firing. The successful and economical performance of a stoker depends, first, upon the proper condition of its parts, and, second, on proper operation (granting, of course, that the locomotive may be in proper condition). The things that constitute proper firebox conditions on hand-fired locomotives similarly apply to stoker-fired locomotives.

It should be understood that a mechanical stoker is in no sense automatic.

For economy in firing locomotives which are equipped with mechanical stokers, the committee recommends the following practices:

Before a fire is built in a locomotive, the distributing features of the stoker should be inspected and known to be in proper condition. The fire should be free from clinkers and banks when the locomotive is delivered to the engine crew.

The stoker should not be used in building up the fire, either by roundhouse force or engine crew. Build up the fire by using the hand shovel. Commence the operation of the stoker as soon after starting the train as conditions require.

The fire should be maintained with the hand shovel when standing, drifting or doing short switching.

Use shovel to build up spots in the firebed which may be thin or undersupplied by the stoker. In that way maintain a uniform distribution of coal over entire grate surface. Every square foot of burning surface requires coal.

Because of the thinness of the fire on stoker-fired locomotives greater care should be exercised when shaking the grates than is required on hand-fired locomotives. If practical, grates should be shaken only when the locomotive is not using steam.

Attention should be given coal as it feeds into conveyor; removing any foreign material which would tend to clog or interfere with the operation of the stoker.

Frequently observe the condition of the fire to know that it is properly maintained. Best results are obtained by continuous stoker operation, care being taken not to crowd the fire.

See that the locomotive, the fire and the firing apparatus are properly adjusted to produce the minimum amount of smoke.

When approaching grades the fire should be properly prepared, to meet the heavier demands. Do not wait until the train is on the grade before speeding up the stoker.

Before beginning a descending grade or before taking on coal the conveyor slides should be closed.

In case the stoker stops, due to clogging by foreign matter, the stoker throttle should be closed before any attempt is made to remove the obstruction. The fire should be maintained by hand until opportunity presents itself to remove the obstruction.

When approaching terminal, have all slide plates closed. This should be done at a sufficient distance so that without waste all coal may be worked out of conveyors. The engine crew should close all valves of stoker apparatus before leaving the locomotive.

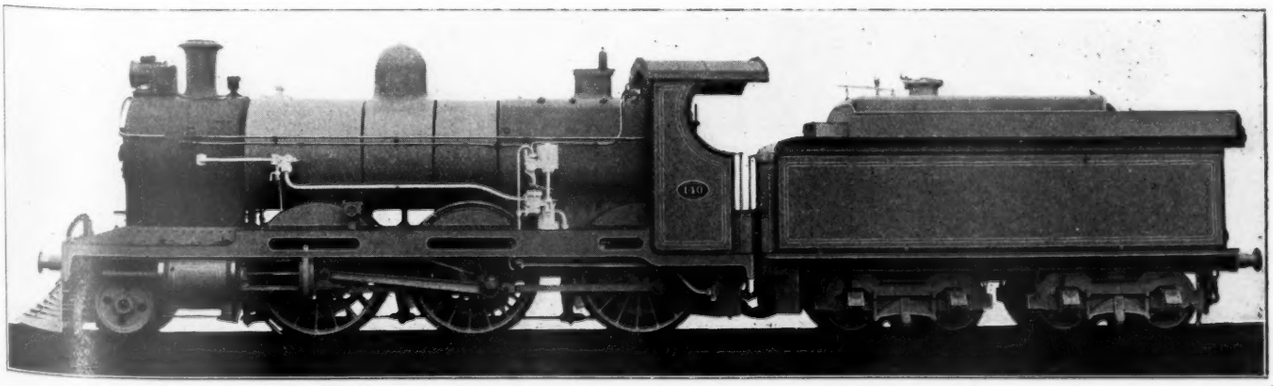
To supervising officers who give attention to fuel, firing practice will always consist of two distinct things: first, the methods themselves for securing practical economy, and, second, the maintenance of those methods in practice. Proper methods are at hand. To develop in every-day routine the habitual use of those proper methods is the unending work of supervising officers.

Habitual clinkers and "banks" in a locomotive fire at terminals usually indicate improper firing, or improper engine handling if no mechanical defects exist. A supervising officer may select one of these extreme cases and proceed to improve the performance. A fair improvement, if permanently effected, could easily save five per cent in coal consumption. Now, since a freight crew burns approximately $15,000 to $20,000 worth of coal a year, the five per cent improvement would amount to $750 or more per case improved. If a supervisor did nothing else but improve five habitual "bankers," this alone would save $3,750, a sum which would go some distance toward paying his salary. But, who would work on only five cases a year? This illustration shows that lack of supervision means waste while well directed supervision means saving.

But it is not only the fireman who sometimes relaxes. Let us consider the engineer. Since the stoker is inanimate, an engineer may become indifferent, and perhaps his fireman too, though he may smile at his escape from a firing abuse that is now borne by a machine instead of by his back. With a locomotive equipped with a mechanical stoker the engineer may not now be able to overburden his fireman, but he is still able to "punish" the engine and the coal pile. Supervision can correct these faults.

The report is signed by M. A. Daly, chairman (Nor. Pac.); D. C. Buell (Railway Educational Bureau); M. Cavanaugh (C. St. P. M. & O.); B. F. Crolley (B. & O.); Chas. P. Dampman (P. & R.); J. W. Dodge (I. C.); J. C. Harris (Sou. Pac. Lines); L. R. Pyle (Locomotive Firebox Co.); F. P. Roesch (Standard Stoker Co.); A. N. Willsie (Locomotive Stoker Co.), and James Wilson.

*Abstract of report to International Railway Fuel Association, Chicago Convention, May, 1922.



Mogul Type Locomotive for Central Uruguay Railway

A standard gage locomotive of the 2-6-0 or Mogul type, built for the Central Uruguay Railway by Beyer, Peacock & Co., Manchester, England. The rated tractive force is 19,640 lb., cylinders 20 in. by 26 in. and driving wheels 72 in. diameter. The boiler is of the Belpaire type, 4 ft. 8 in. diameter of first ring outside, with steel firebox, and carries 160 lb. pressure. It is equipped with Schmidt superheater and arranged for burning oil. The weight of the locomotive in working order is 119,500 lb. of which 97,380 lb. are on the drivers. The tender has a capacity of 3,500 gal. of water and 1,560 gal. of fuel oil. The weight, loaded, is 101,300 lb. The trucks have 36½ in. wheels and a wheel base of 10 ft.

AIR BRAKE CORNER

Repairing Leaky Hose Fittings

Question.—I would appreciate it if you could furnish suggestions for repairing air hose fittings which have small sand holes in them.—J. C. G.

Answer.—Small leaks may sometimes be stopped by peening. In other cases it may be necessary to drill, tap and screw in a small brass plug. If the leakage occurs over a considerable area, as would probably be the case should it be due to shrinkage causing a porous spot, it would be best to scrap the piece as such a defect cannot be corrected with any assurance that it will remain tight.

Blow-Down Timing Port in ET Brake Valve

Question.—What is the function of the blow-down timing port in the automatic brake valve used with the ET equipment? Does it aid in overcoming leakage?—R. J. K.

Answer.—The blow-down timing port in the automatic brake valve is operative only in emergency applications. Its function is to bring about a higher emergency cylinder pressure and consequently a shorter stop than would result from the equalization between the pressure chamber and the application cylinder. The blow-down gives an action somewhat similar to that obtained from the high speed reducing valve used with older equipments. It was not incorporated in the valve to take care of leakage.

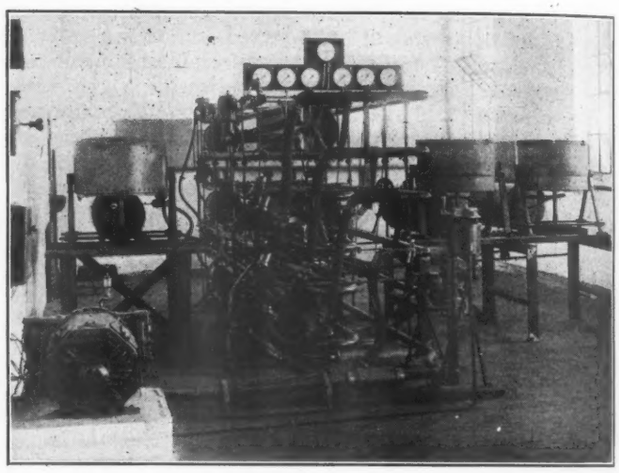
ET Brakes Leak Off

Question.—What is the cause of the following action noticed on a detached locomotive having the ET brake equipment? After the system had been fully charged the automatic brake valve was placed in service position and left there. The driver and tender brakes applied and the gage showed 50 lb. brake cylinder pressure—the initial brake pipe pressure having been 70 lb.—but the brake cylinder pressure soon began to drop.—R. J. K.

Answer.—The driver brakes will not leak off quickly unless the equipment is in poor condition and such action will not take place under average or ordinary conditions. The action noted is due to leakage from the piping or connections to the application chamber or to leakage back through the graduation or equalizing slide valve of the distributing valve. Use a soap suds test to determine the point of leakage.

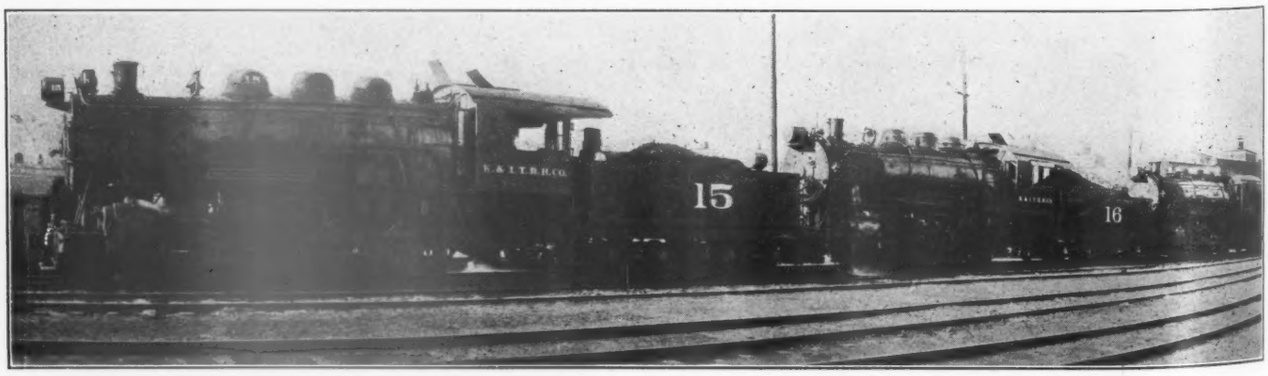
Test and Demonstration Rack for Vacuum Brakes

THE Consolidated Brake & Engineering Company has in use at its works at Slough, England, a six-car test and demonstration rack of the vacuum brake equipment as applied to electrically operated trains, such as those on the London District Railway. This is a two-line system with a brake pipe and a reservoir or release pipe. The vacuum is created by a motor-driven exhauster, a vacuum of 20 in. of mercury being maintained in the brake pipe, brake cylinder and reservoir and 26 in. in the releasing reservoir and communicating release pipe. The apparatus for a car in addition to brake cylinders, reservoirs, ball valves, driver's brake valves and guard's emergency valve includes a vacuum governor, rapid action application valves and release valve.



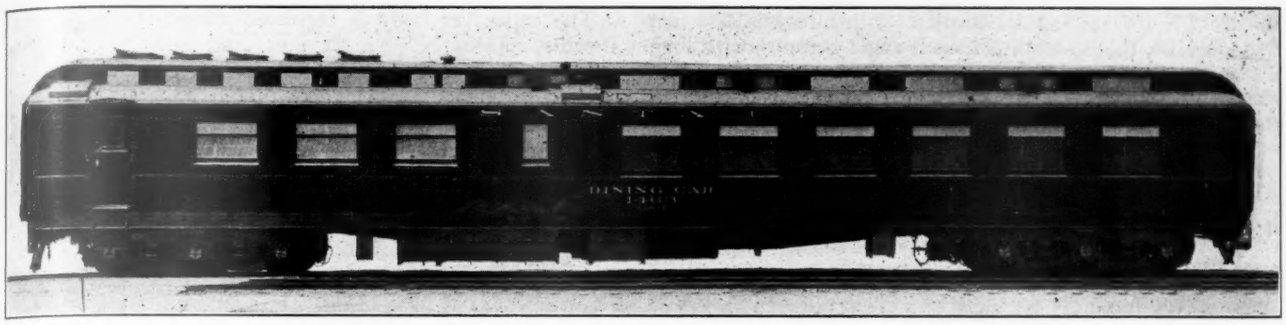
Test Rack for Vacuum Brakes on Electrically Operated Equipment

On brake equipment for such service it is necessary not only to provide for quick application, but also for a quick release and recharge. With the apparatus used a release after a service application can be made in 3½ sec. to 5 sec. and after an emergency application, in 7 sec. to 9 sec. On the London District Railway the average stopping time during slack hours is 12 sec. to 15 sec., and from 25 sec. to 45 sec. during the rush hours when a large number of passengers are handled. There is thus no delay due to the time required to release and recharge the brakes, the time required being less than the stopping time.



Eight-Wheel Switchers on the Kentucky & Indiana Terminal

Five new locomotives enabled the Kentucky & Indiana Terminal to handle the largest number of cars in their history without an embargo for the past three years. These locomotives are of 49,700 lb. tractive effort, weigh 208,700 lb. on drivers, have 24 in. by 28 in. cylinders, 51 in. driving wheels, 2,443 sq. ft. heating surface, 41.7 sq. ft. grate area and carry 185 lb. boiler pressure.



Santa Fe Dining Car from the Kitchen Side

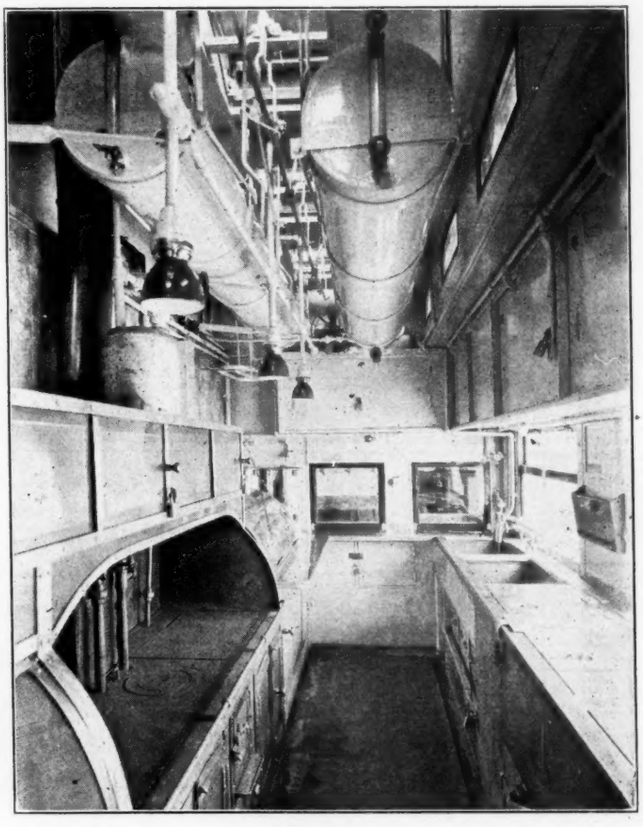
Santa Fe Acquires Eight All Steel Dining Cars

Length Over End Sills is 80 ft. 6 in. and Total Weight 171,000 lb.; Dining Room 38 ft. 8 in. Long Seats 36

THE Atchison, Topeka & Santa Fe has recently received from the Pullman Company eight all steel dining cars. The cars are without vestibules, are 80 ft. 6 in. long over the end sills and weigh 171,000 lb. The dining rooms are 38 ft. 8 in. long and have a seating capacity of 36 at six single and six double tables. The tables are spaced 6 ft. 5 in. apart from center to center, which is 2 in. greater than the spacing on the older diners of this road.

Essentially the design of these cars is the same as that of the other all steel equipment of the Santa Fe, the first of which was built in 1914.* The underframe is designed to carry the load and consists of fish-belly center sills built up of plates and angles, channel side sills, and bolsters and cross bearers built up of channel pressings and cover plates. One of the principal differences in the design of the present cars is the use of structural channel sections for the side sills replacing the built-up sections employed in the first steel coaches. The body frame members are largely of pressed steel. The corner posts and side plates are rolled Z-sections, with the balance of the side posts and cripples of pressed Z shapes. The belt rail is a continuous piece of 4-

Daylight View of the Dining Room

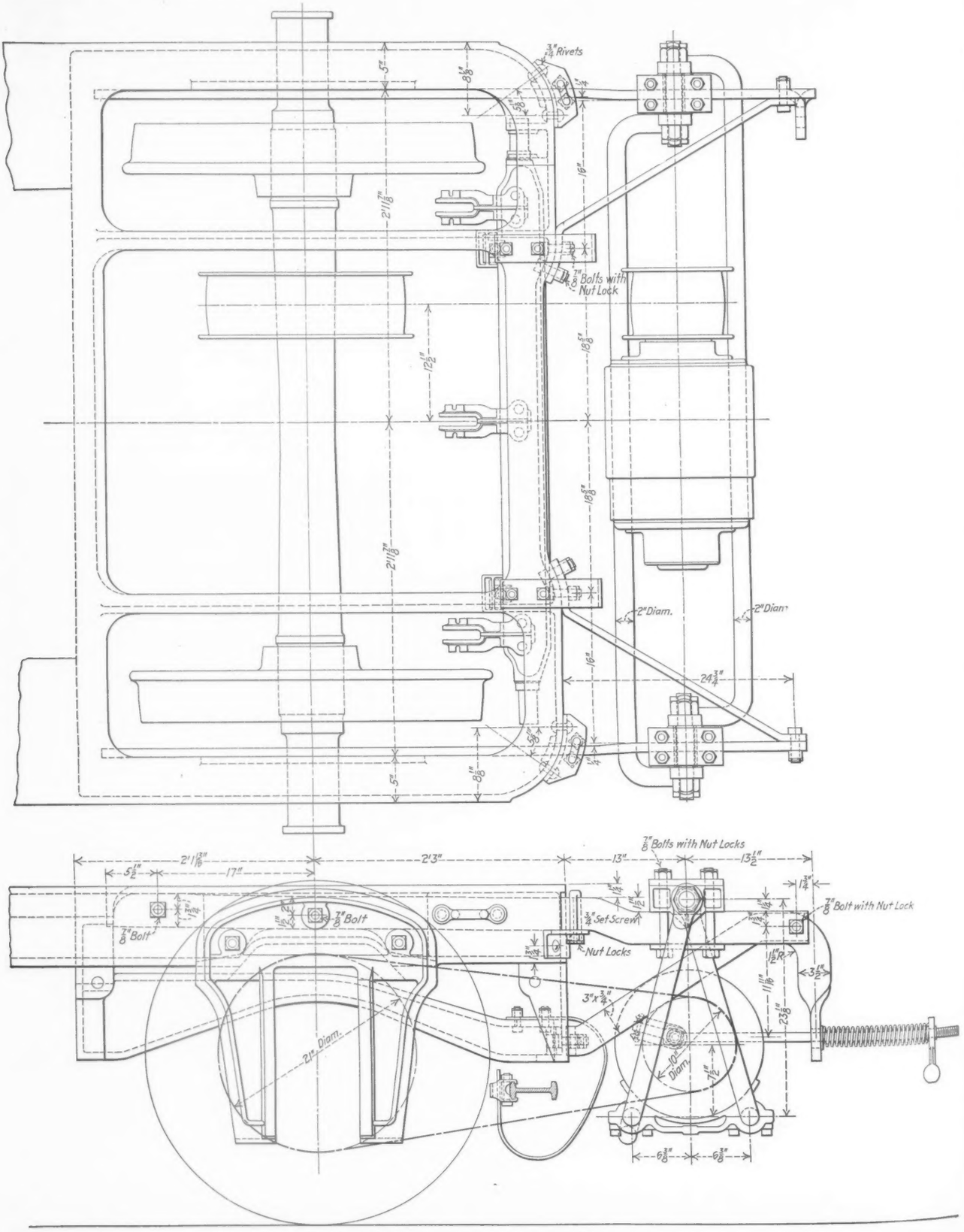


The Kitchen, Looking Toward the Pantry

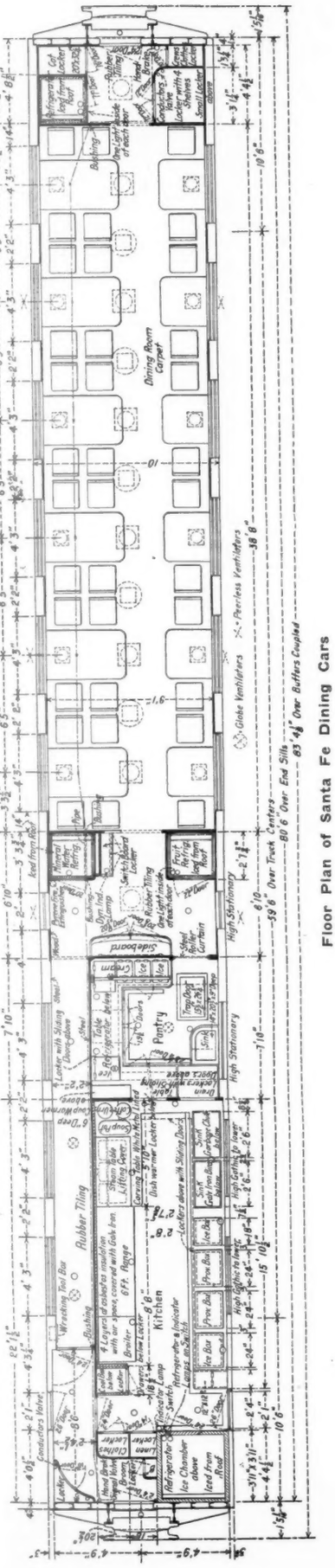
* See the *Railway Age Gazette*, Mechanical Edition, for January, 1915, page 21.

in. by 1½-in. rectangular section, with pressed Z-section window sills, the deck sill a special angle pressing with long horizontal flange and the deck plate and carlines of pressed channel section, the latter with closed ends. The sides of the cars are sheathed with ⅛-in. steel sheets.

The entire car body is insulated with a ½-in. layer of Insulite applied between the posts and carlines against the outside sheathing and roof sheets. The underframe is covered throughout with a floor of No. 16 galvanized steel, which is coated on both sides with Lucas car roof cement.



Truck Suspension for Car Lighting Generator



Floor Plan of Santa Fe Dining Cars

On this is laid the Insulite, the top of which is covered with a heavy coat of petroleum asphalt, mopped on hot. The floor is then laid on transverse nailing strips of yellow pine. The dining room floor consists of a single thickness of 7/8-in. tongued and grooved yellow pine flooring. A double floor of the same material is laid in the kitchen while the single wood floor in the corridor is covered with Flexolith and surfaced with 1/4-in. rubber tiling. The thickness of the nailing strips in the kitchen and corridor is reduced so that the surface of the floor is flush throughout the car. The kitchen floor is surfaced with sheet copper with all joints and nail heads soldered.

The interior finish of the dining room is of wood throughout and is built up of five-ply veneer Mexican mahogany. At all bearings, both on the sides and ceiling, the wood is backed with heavy canton flannel to prevent creaking. The steel interior finish in the kitchen, pantry and hallway is of 1-16-in. sheet steel, and is backed with one course of No. 12 fireproof duck secured to the sheets with glue.

The arrangement of facilities in the car is clearly shown on the floor plan drawing. There are four refrigerators iced from the roof, the largest one located in the kitchen at the end of the car. Two of the others are located against the partitions at the kitchen end of the dining room, one on either side of the car, and the third against one of the partitions at the opposite end of the dining room. In addition to ice boxes in the kitchen and pantry, a large ice box for meat storage is located under the car, to which access is had through a trap door in the pantry floor.

Side doors with 2-ft. 1-in. openings are located on either side of the car 4 ft. 4½ in. back from the end. The door from the corridor into the kitchen is directly in line with these doors. The outside door on the kitchen side is in two sections arranged so that the upper section may be opened independently of the lower.

Power for the electric lights and fans is provided by the U. S. L. axle light system, with truck suspended generator. This truck suspension, which is of Santa Fe design, is shown in one of the drawings. It has few wearing parts and its strength and the security with which it is attached to the truck are attested by the fact that no failure resulting in the loss of a generator has ever been reported. The cradle is of triangular form and is suspended by a single hanger pin at each end. The suspension is secured to the truck frame by two 3½-in. by 1-in. steel bars passing through cored openings in the ends of the truck frame and bolted to the inside face of the side rails. Where these bars emerge from the frame openings they are secured by clamps to angle brackets riveted to the frame casting. The inner ends of the bars bear upward against the flange of a frame cross member, thus relieving the bolts of shear. The suspension bars are braced laterally against the truck frame end rails.

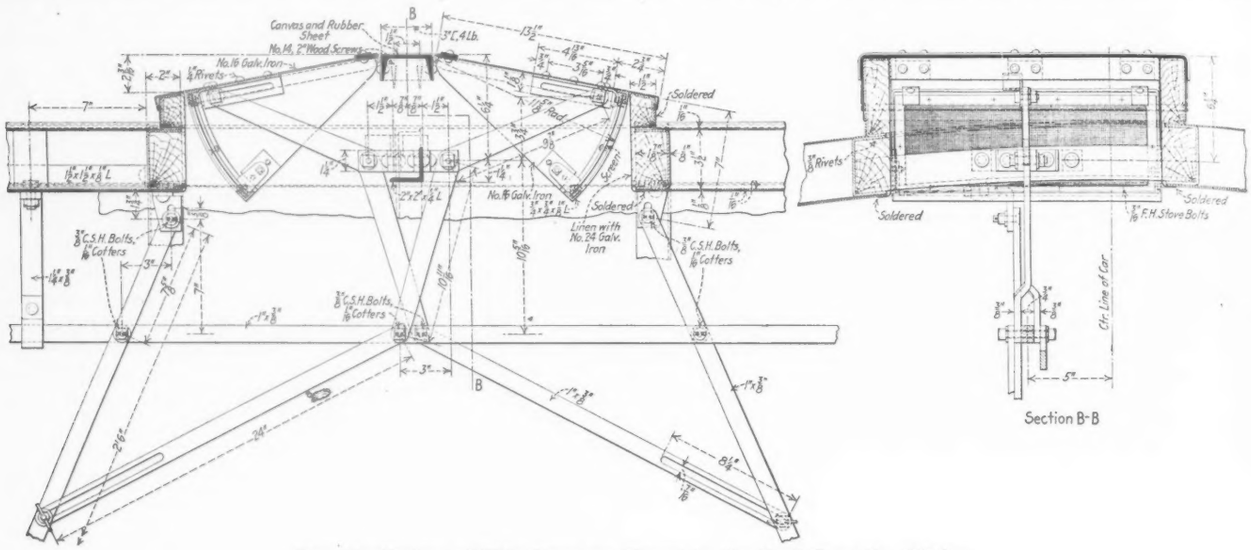
The dining room is lighted by six center fixtures and six fixtures in the ceiling of each lower deck. Safety lamp fixtures are used throughout; those in the center are enclosed in 12-in. bowls and those on the side in 8-in. bowls. Five ceiling fans, of the revolving shutter type, are placed between the ceiling lamps.

The cars are heated by the Vapor Car Heating Company's thermostatically controlled vapor system and three types of ventilators are used. The dining room is served by four Peerless ventilators opening through the deck sash, and two of these ventilators are also located about the hall between the dining room and pantry. Globe ventilators are placed in the roof above the corridor and the pantry, two in the corridor and one in the pantry.

Five adjustable ventilator hatches with hinged covers of the type shown in one of the drawings, operating as a unit, are placed in the center of the roof over the kitchen. The hatch openings are 16 in. wide and when the covers are fully raised, each provides a direct screen covered outlet of about 77 sq. in. at either end. The hatch covers of each

ventilator are hinged transversely at the center and are operated separately, depending on the direction in which the car is running.

The cars are carried on six-wheel cast steel trucks, located



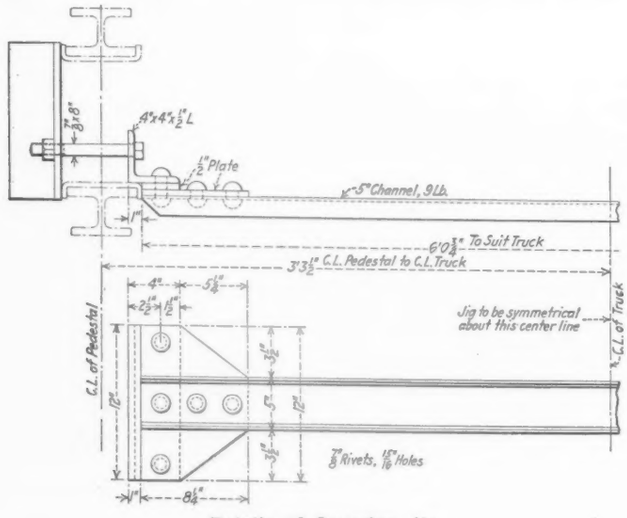
Fine Ventilators of This Type are Placed in the Roof Over the Kitchen

59 ft. 6-in. apart, center to center, with 5½-in. by 10-in. journals and a wheel base of 11 ft. They are fitted with Barber roller center plates and side bearings, and Simplex clasp brake rigging. The airbrake equipment is of the Westinghouse UC type providing at 60 lb. cylinder pressure a braking power of 90 per cent.

Squaring Jig for Car Trucks

By E. A. Miller

IN erecting passenger car trucks it is essential that the side frames be lined up square so that the pedestal jaws are in the correct position. As this is an important job and often takes considerable time, several devices have been designed on different roads to facilitate the work and secure accurate



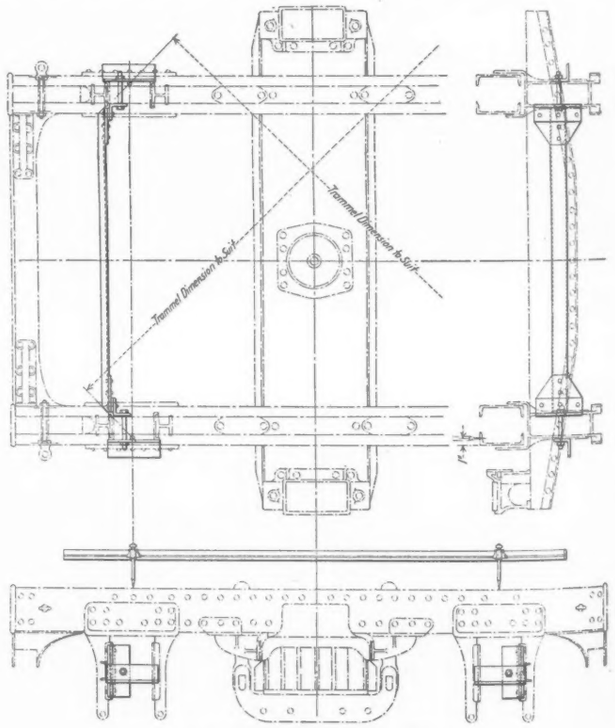
Details of Squaring Jig

results. The arrangement shown in the accompanying illustrations is one which has been successfully used in several large car shops.

The jig is made of a length of 5-in. channel, 9 lb. per foot, having two pieces of ½-in. plate and a 4 in. by 4 in. by ½ in. angle riveted to each end as shown in the detail drawing. It is clamped at the ends by a ⅞-in. bolt and a piece of 4 in. by 4 in. by ½ in. angle which sets across the pedestal legs.

Two jigs are required for a four-wheel truck. The length can be arranged to suit the design of truck and pedestals.

These jigs are used in building new trucks or in repairing old ones when the end rail is to be renewed or reriveted, being



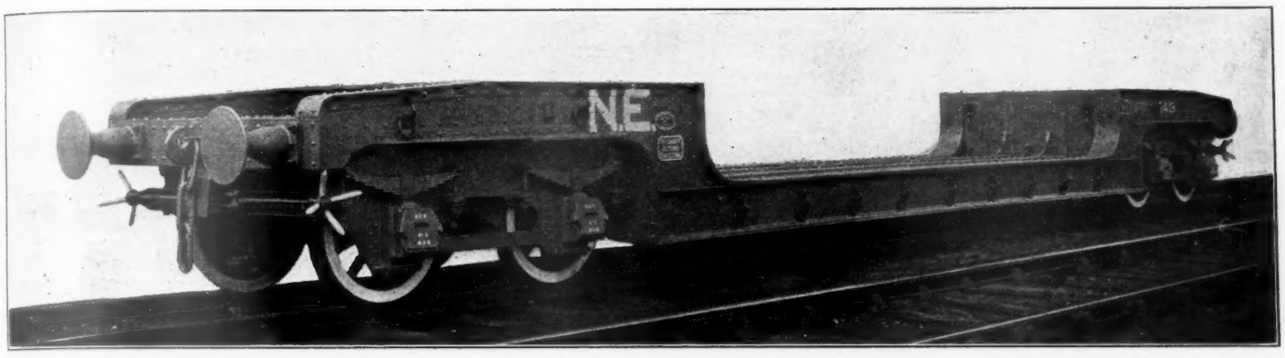
Application of Jigs to a Truck

applied to the pedestals and loosely bolted as shown in the large drawing. The frames should then be pulled square by means of chains with turnbuckles across diagonal corners, making the trammel distances across the opposite corners equal.

After the frames have been pulled square and the bolts in the end of the jig tightened up, the rivet holes in the end rail connections should be reamed true and the frames riveted.

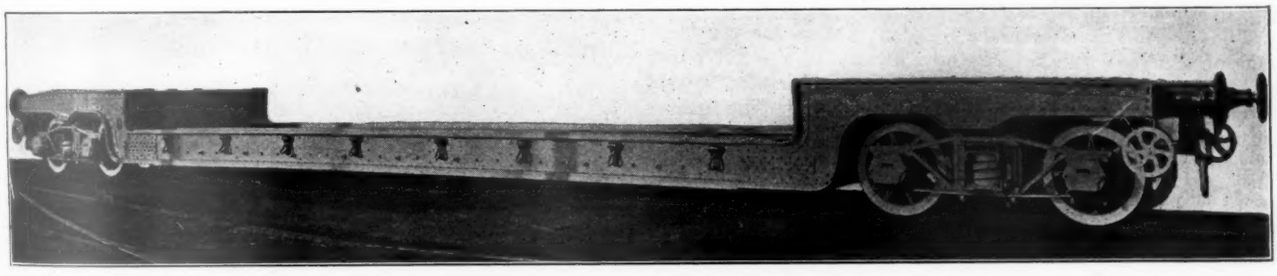
Some British Well Cars

SPECIAL forms of freight cars are much more frequently employed in Great Britain than in this country. Of such cars those of the well or gap type are often used to transport heavy or bulky machinery. The accompanying photographs show three forms of well cars built by Stableford & Co., Coalville, for the North Eastern Railway, according to designs of Sir Vincent L. Raven, chief mechanical engineer of the road.



50 Ton Car with 25 Ft. Well

The 50-ton car is 48 ft. 8 in. long over the end sills, 7 ft. 9 in. wide and has a well 25 ft. long. The height when unloaded is 4 ft. 8 in. at the truck and 2 ft. 2 in. at the center. The side sills are built up of two 5/8-in. plates with 3½ in. by 3½ in. 11 lb. angles at the top and bottom with 12 in. by ½ in. cover plates. The two intermediate sills are composed of one 5/8-in. plate with 3½ in. by 3½ in 11-lb. angles at top and bottom on both sides and 8 in. by ½ in. cover plates. In the well portion all sills are built up of two 15 in. by 4 in. 42 lb. channels with 12 in. by ½ in. cover plates.

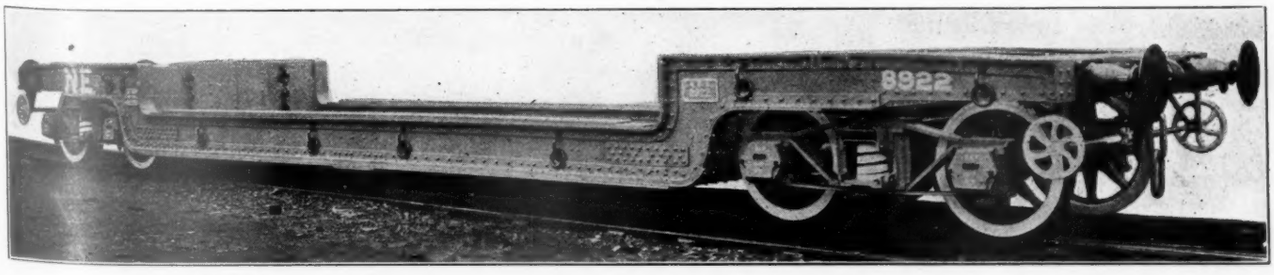


40 Ton Car with 34 Ft. 6 In. Well

The trucks are of unusual design and have both outside and inside bearings, the former being 5 in. by 10 in. and the latter 5½ in. by 10 in. Semi-elliptic springs are used on both the outside and inside journal boxes. The wheels are steel tired, 37 in. in diameter, the wheel base 5 ft. and the distance between centers of trucks 38 ft. 6 in. The drawgear pulls on three 9½-in. diameter, India-rubber springs back of the end sill; the side buffers also contain India-rubber springs. Screw type hand brakes, for each truck separately, can be operated from the ground by the hand wheels shown near the car ends.

The 40-ton car with a 34 ft. 6 in. well is 55 ft. 6 in. long over end sills, 8 ft. wide and 45 ft. 6 in. between centers of truck. The height at trucks is 4 ft. 0¾ in. and 2 ft. 4¾ in. at the center. The side sills are built up of two 15 in. by 4 in. 42 lb. channels and 12 in. by ¾ in. plates at top and bottom. There are no intermediate sills, the side sills being joined by two fixed and nine adjustable cross bars formed of 5 in. by 5 in. 24 lb. I-beams. The trucks are of the diamond arch bar type with 33-in. steel tired wheels and 5 ft. 6 in. wheel base. The journals are 5 in. by 10 in. The drawgear pulls on the body bolsters through India-rubber springs composed of two sets of four each.

The 40-ton car with a 25 ft. well is 46 ft. long over end sills and 8 ft. 4 in. wide. The height at the trucks is 4 ft. 1⅛ in. and 2 ft. 6 in. at the center. The frame is constructed of ¾-in. plates stiffened by 4 in. by 3 in. 13½-lb. angles and 7 in. by ¾ in. plates at top and bottom. The trucks, which are spaced on 36-ft. centers, the draft gear and many details are the same as on the longer 40-ton car.



40 Ton Car with 25 Ft. Well

Recent Decisions of the Arbitration Committee

(The Arbitration Committee of the A.R.A. Mechanical Division is called upon to render decisions on a large number of questions and controversies which are submitted from time to time. As these matters are of interest not only to railroad officers but also to car inspectors and others, the Railway Mechanical Engineer will print abstracts of decisions as rendered.)

Requirements of Class E, Rule 112

New York, Chicago & St. Louis cars No. 5784 and No. 7426 were destroyed on the Philadelphia & Reading February 6, 1921. The owner furnished an appraisal to the latter road under Class E, Rule 112. The Philadelphia & Reading contended that the cars should be appraised under Class F. The cars had metal draft sills weighing 34.4 lb. per ft., which were not fitted with continuous cover plates. The third paragraph under Class E, specifies not less than 8 in. continuous metal draft members of not less than 18 lb. per ft. per member, securely fastened to wood center sills of not less than 4-in. by 8-in. sections. On these cars the 34.4-lb. sills replaced the wood center sills and were not directly attached to the remaining wood sills. The New York, Chicago & St. Louis contended that, since the metal sills had 6-5/16-in. flanges with lateral supports well within the maximum of 20 times the width of the flange and extra wide bottom tie plates between the lateral supports, the metal sills were in effect securely fastened to wood sills of greater than the required section and would not buckle between supports under fair usage.

The Arbitration Committee decided that as the construction of the cars did not conform to any of the preceding classes in the table under Rule 112, the settlement should be made under Class F, as stated in note 1 under the rule.—*Case No.* 1217, *N. Y. C. & St. L. vs. P. & R.*

Kicking Cars Without Rider Protection a Handling Line Risk

Atlanta, Birmingham & Atlantic flat car No. 5404 was broken in two in a repair yard of the Indiana Harbor Belt when four cars were kicked against the string in which it was standing, on November 11, 1920. The car was old and the broken sills were decayed. The Indiana Harbor Belt claimed that the car was damaged in ordinary switching. The Atlanta, Birmingham & Atlantic contended that the kicking of cars in switching movement caused "impact other than that occurring in regular switching" and that the handling line was responsible because no rider protection was provided when the damage occurred.

The Arbitration Committee sustained the contention of the car owner.—*Case No.* 1224, *Indiana Harbor Belt vs. Atlanta, Birmingham & Atlantic.*

Responsibility for Damage to Car Under Footnote to Rule 43

Norfolk & Western car No. 19234 was found in damaged condition in the Madison, Ill., yard of the St. Louis Merchants' Bridge Terminal Railway on March 5, 1921. The Norfolk & Western was requested to furnish disposition for the car under Rule 120, but the car owners declined to authorize disposition until the Terminal Railway had furnished a statement showing the manner in which the damage to the car occurred, according to the intent of the footnote under Rule 43. The Terminal Railway Association was unable to furnish definite information as to the circumstances under which the damage occurred, other than the fact that the car was found in a damaged condition between two other cars, neither of which showed evidence of damage or rough handling.

The Arbitration Committee decided that the note under Rule 43 requires the handling line to submit a report showing the circumstances under which damage to the extent testified occurred, if it is claimed to have been under conditions of ordinary handling. As the St. Louis Merchants' Bridge Terminal Railway is unable to furnish this information it must assume responsibility.—*Case No.* 1219, *Norfolk & Western vs. St. Louis Merchants' Bridge Terminal.*

Responsibility for Missing and Damaged Parts of Car Body

Gulf & Ship Island gondola car No. 748 was offered to the owner in interchange by the Mississippi Central on November 26, 1920. The car inspector for the Gulf & Ship Island refused the car because of a number of missing side and end planks and side stakes. The Mississippi Central refused to issue a defect card and made the repairs in its own yard. Bill for the repairs was refused by the owner on the ground that the delivering line was responsible under interpretation No. 6, Rule 32, known theft of parts of car on the handling line. The Mississippi Central received the car in interchange properly side carded for bad order home movement, and claimed that the car was a converted flat car, the side stakes of which were not bolted to the sills and the planks spiked to the stakes.

The Arbitration Committee decided that there was no evidence of unfair usage under Rule 32, the owner accordingly being responsible for the repairs.—*Case No.* 1227, *Mississippi Central vs. Gulf & Ship Island.*

Incorrect Inspection Report Given Car Owner Under Rule 120

Gulf & Ship Island flat car No. 1092, was removed from service for heavy repairs at the Albuquerque, New Mexico, shop of the Atchison, Topeka & Santa Fe on December 14, 1920. On receipt of inspection report and request for disposition under Rule 120 the owner authorized the Santa Fe to load this car on another and ship it home, freight collect, rendering a bill for the cost of loading. When the car reached home the owner had a joint inspection made which indicated the need for considerably less work than that shown on the original inspection report rendered by the Santa Fe. Later, another joint inspection by a representative of the Santa Fe and of the car owner again disclosed that a number of parts reported defective on the original inspection were in sufficiently good condition not to require renewal. The Gulf & Ship Island claimed that the bill for loading the car should be cancelled and that the Santa Fe should pay the freight charges for the shipment of the car from Albuquerque, New Mexico, to Gulfport, Miss. The Atchison, Topeka & Santa Fe claimed that, since the Gulf & Ship Island did not avail itself of an opportunity for a joint inspection before shipment of the car, and that, since Rule 120 provides for no other course than to dismantle or repair, making the loading and shipment of the car a matter of accomodation to the car owner, the latter should assume the responsibility for the loading and transportation charges.

The Arbitration Committee decided that, since the joint inspections indicated an incorrect original inspection report, the Santa Fe cancel its bill for cost of loading and pay the freight charges.—*Case No.* 1222, *Gulf & Ship Island vs. Atchison, Topeka & Santa Fe.*

Denver & Rio Grande Western 70-Ton General Service Gondola Car

70-Ton D. & R. G. W. General Service Gondola Car

High Capacity Car of Unusual Design Adopted by a Western Road for Miscellaneous Bulk Freight

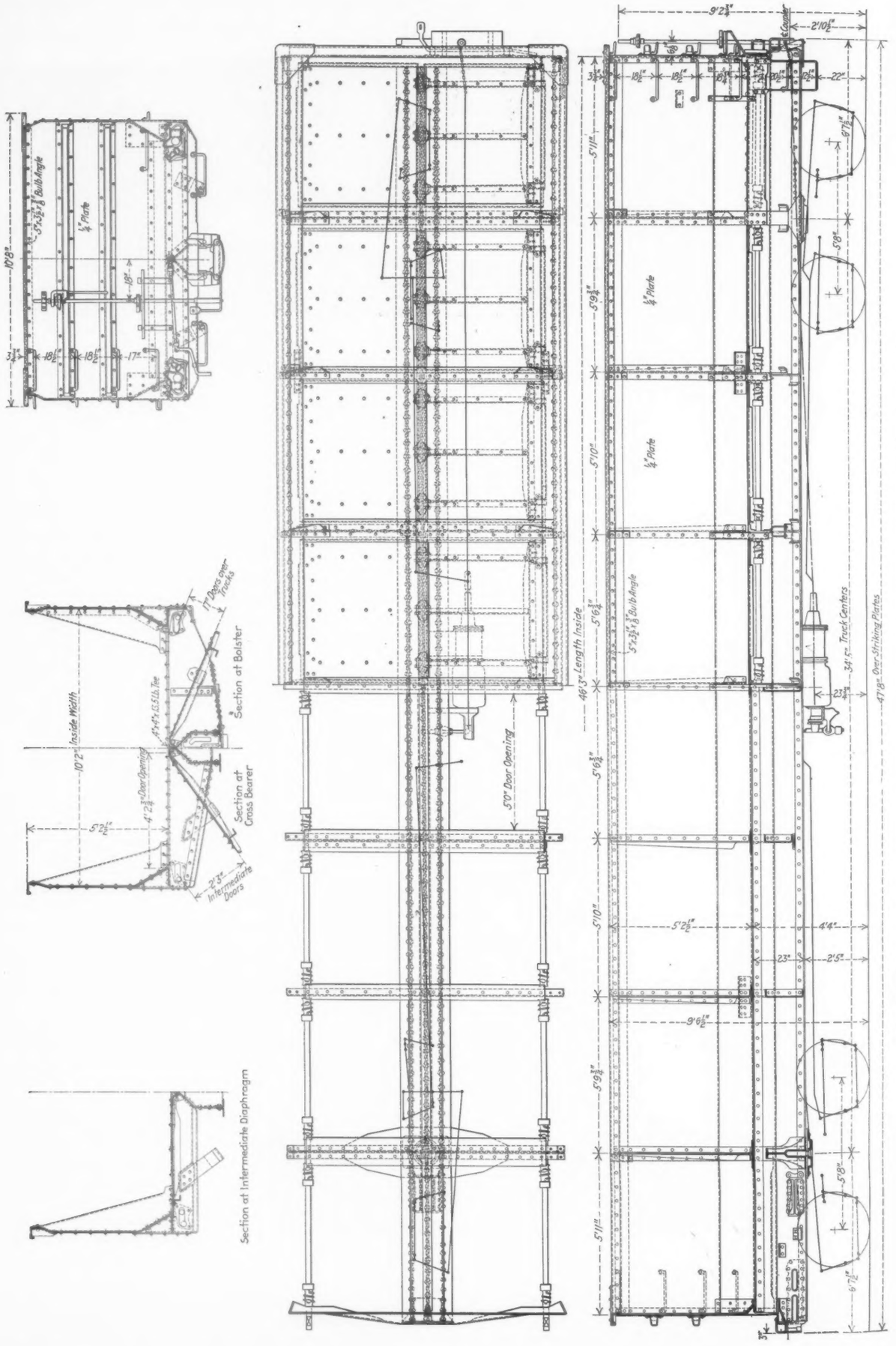
THE Denver & Rio Grande Western has recently received from the Hegewisch plant of the Pressed Steel Car Company 700 gondola cars which are of more than ordinary interest as they are of a larger capacity than has been used hitherto on any Western road, are of a relatively low light weight in proportion to the load carried and embody features of design which make the car suitable for handling various kinds of bulk freight. The cars primarily are intended for transporting coal but can be used for ore, coke, lumber or any kind of freight that can be handled in open top cars of either the drop or solid bottom types. There are 16 drop doors with large openings and side discharge. When the doors are closed the bottom is level and smooth. Provision is also made for temporary side stakes and racks should they be required for light materials. The length inside is 46 ft. 3 in., the width 10 ft. 2 in., and the depth from top of sides to floor 5 ft. 2½ in., which gives 2,400 cu. ft. capacity. The height from the top of the rail to the top of the car side has been kept quite low, being only 9 ft. 6½ in.

Interior of Car Showing Gussets, Doors in Open Position

Construction of Underframe

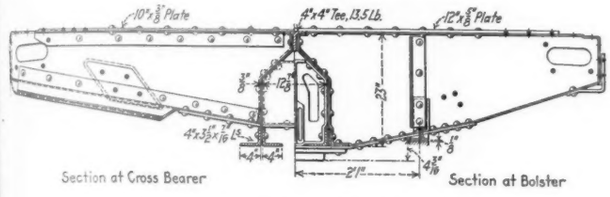
The center sill is of the A-frame type, 23 in. deep, composed of two ⅜-in. web plates spaced 12⅞ in. apart at the bottom and brought together at the top with a rolled 4 in. by 4 in., 13.5-lb. tee riveted between. The bottom edge of each web plate is reinforced with two 4 in. by 3½ in. by 7/16 in. angles. The center sills have an area and ratio of stress to end load 15 per cent in excess of the present A. R. A. recommendations, the center sill area being 34½ sq. in. and the ratio .0425. The sills are continuous from end to end and are heavily reinforced at the end with a steel striking casting for the coupler horn.

The body bolsters are built up with the underframe, each being formed of four pressed steel plates ¼ in. thick with wide flanges placed back to back and a cast-steel center


Side Elevation, Plan, End View and Sections of Denver & Rio Grande Western 70-Ton Gondola Car
Section at Bolster
Section at Cross Bearer
Section at Intermediate Diaphragm
Inside Width
Door Opening
Intermediate Doors
Length Inside
Truck Centers
Over Striking Plates
Bulb Angle
Plate

brace between the center sills. The bolster is reinforced by a 12 in. by 5/8 in. cover plate on the top and a 3/8 in. plate, 23 in. wide on the bottom to which the cast steel center plate is attached. The side bearings are spaced 4 ft. 2 in. between centers and consist of hardened steel plates, a clearance of 1/8 in. being allowed between the side bearings on the body bolster and those on the truck. Jacking plates are riveted to the outer ends of the bolsters. The construction of the bolster is shown in the drawing below.

Pressed steel shapes, 1/4 in. thick, also are used for the two cross-bearers and the intermediate and center diaphragms as well as for the short diaphragms placed between the center sills. The crossbearers are reinforced by a 10 in. by 3/8

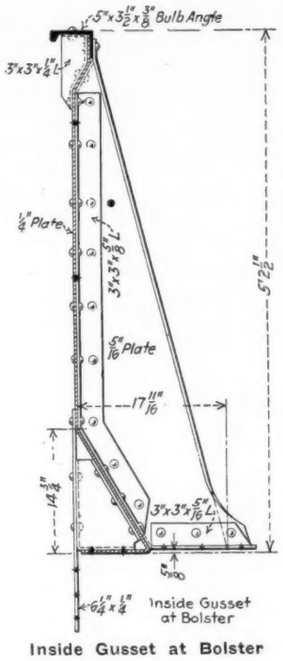


Sections at Cross Bearer and Bolster

in. cover plate and a 3 in. by 3 in. by 1/4 in. angle at the top and a 6 in. by 7/16 in. plate and a 3 in. by 2 1/2 in. by 1/4 in. angle at the bottom. The three diaphragms, at the center and between the bolsters and side bearers, have 7 in. by 3/8 in. cover plates.

Side and End Construction

The side is of a particularly rigid construction. The 1/4 in. plates are reinforced at the top with a 5 in. by 3 1/2 in. by 3/8 in. bulb angle, and the top of the side is set in, which, in conjunction with the bulb angle, forms a box construction, adding stiffness to this part of the car. It will be noted from the illustrations that there are no outside stakes, the side being braced vertically on the inside with gusset plates located at each of the cross members of the car. The gusset plates are flanged on the inside vertical edge to form a flat bearing surface for long materials. The bottom of the side is sloped in to the edge of the door and then bent back in a horizontal plane to make this part of the car self-clearing and to add stiffness. With this construction it is possible to obtain the required cubic capacity with the least height and length of car as the side sheets can be brought out to the clearance line. The gussets are provided with holes for the attachment of temporary inside stakes for securing racks when light material is carried.

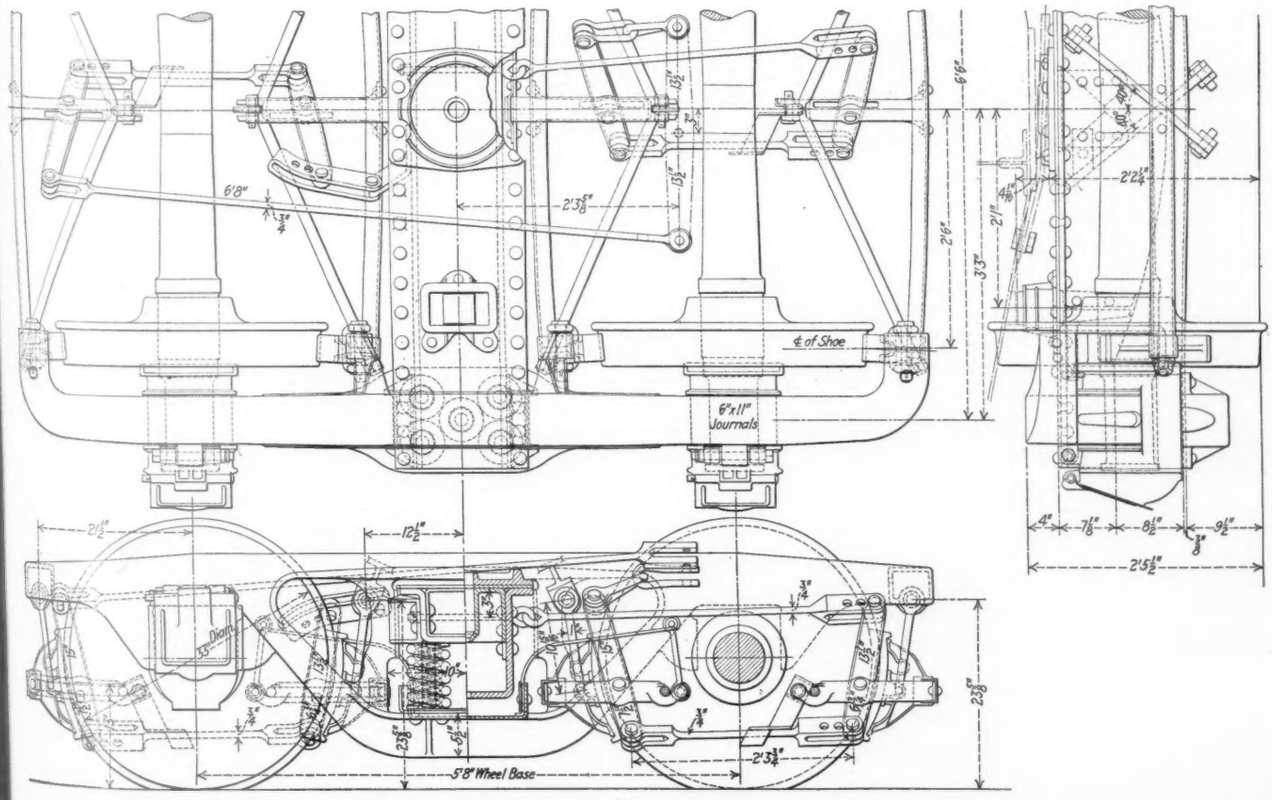


Inside Gusset at Bolster

The end is thoroughly braced by 5 in. by 3 1/2 in. by 3/8 in. bulb angle at the top and two horizontal U-shape braces extending from side to side of the car and is also provided with an inside slope sheet at the bottom to make this part of the car self-clearing and to increase the strength.

Doors and Operating Mechanism

The door openings are 5 ft. wide and 4 ft. 2 3/4 in. from the center sill to the sloping side sheet, thus forming practically



General Drawing of Four-Wheel Truck with Clasp Brake

Side Elevation, Plan, End View and Sections of Denver & Rio Grande Western Tower

the entire floor area. The discharge opening of the eight doors in the center portion of the car is 2 ft. 3 in. and of the eight doors over the trucks, 17 in. The discharge area is thus 146.7 sq. ft. The doors are hinged to the center sills and when dropped form a ridge sloping from the center of the car to both sides, thus providing for the discharge of the lading to both sides and clear of the track. A slight elevation of the track is sufficient to provide complete clearance of the lading, such as coal, ballast, sand or similar material so that the car can be dumped quickly and moved away without further work.

The door operating mechanism is of the Lindstrom-Streib design. This provides for the support of the doors by the operating shafts which run longitudinally through the car on either side. These shafts are connected by two ordinary chains to each door. The operation of opening the doors is simple and consists merely of rolling the shaft out from under them, which is done by means of the operating socket located at the corner of the car with the use of a crowbar or piece of pipe, thus allowing the doors to drop and discharge the lading. Heavy supports or stops are provided in the underframe which absorb the shock from the dropping of the doors when opened, and support them in the proper position while the lading is being discharged. The doors are closed by revolving the shaft in the opposite direction, the chains winding on worms attached to the shaft raising the doors until they are in the closed position, when by continued turning of the shaft it rolls under the doors and supports them directly, relieving the chains of all strains. At no time is there any load on the door chains, except the weight of the doors while they are being closed. The operating socket, located at the corner of the car, is absolutely "fool-proof," it being impossible to transmit any of the force of the dropping load to the operator while dumping the car.

To resist abuse to which the doors are often subjected in loading they are made of ¼-in. pressed steel plates, rigidly braced with three 3 in. by 2½ in. by ¼ in. angles and one 4 in., 8.2 lb. Z-bar and hinged to the center sills with heavy steel hinges and cast steel hinge butts. To meet the railroad company's requirements the doors are fitted up tight in order to retain fine coal and very fine ore.

CAPACITY, DIMENSIONS, WEIGHTS AND PROPORTIONS

Capacity:	
Stencilled, nominal	140,000 lb.
With 10 per cent overload	154,000 lb.
Cubic capacity, level	2,400 cu. ft.
Dimensions:	
Length over striking plates	47 ft. 8 in.
Coupled length	50 ft. 2 in.
Truck centers	34 ft. 5 in.
Truck wheelbase	5 ft. 8 in.
Height, rail to top of car side	9 ft. 6½ in.
Height, rail to top of floor	4 ft. 4 in.
Height, rail to center plate bearing	2 ft. 2⅜ in.
Height, rail to underside body side bearing	2 ft. 6 9/16 in.
Length, inside	46 ft. 3 in.
Width, inside	10 ft. 2 in.
Depth, inside	5 ft. 2½ in.
Width, outside, extreme	10 ft. 8 in.
Weights:	
Light weight of car	55,500 lb.
Loaded with 10 per cent overload	209,500 lb.
Proportions:	
Weight loaded per foot coupled length	4,175 lb.
Rail load per axle, loaded	52,375 lb.
Per cent revenue load of total weight	73.5

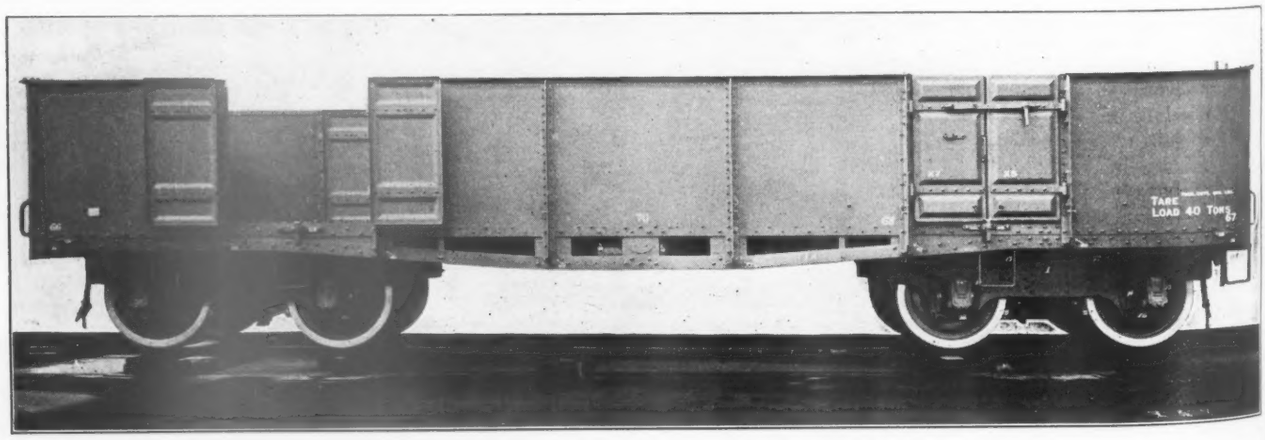
Four-Wheel Trucks Equipped with Clasp Brakes

The four-wheel trucks have a wheel base of 5 ft. 8 in., rolled steel wheels, and 6 in. by 11 in. journals. The cast steel side frames are of the Vulcan-Floyd type made by the American Steel Foundries. The truck bolsters are of the pressed steel bath-tub type made by the Pressed Steel Car Company, as are also the brake beams. The trucks are equipped with drop forged center plates and Stucki roller side bearings.

As there are severe grades on portions of the road, particular attention has been given to the brake rigging. Instead of using the single brake which is practically universal for freight equipment, a clasp brake has been adopted. Brake beams of the A. R. A. No. 2 plus design are used for both the inside and outside brakes. They are suspended from extensions cast on the side frames by 1 in. hangers with forged eyes. The outside brake beams are retained in place by a third point support resting on the bottom brake rod and the inner beams by a spring attached to the spring plank.

The brakes are operated by the Westinghouse Air Brake Company's equipment, KC-1012, with 10-20 lb. retainers, and the hand brakes by the Perfection brake ratchet device. The braking power is 80 per cent of the light weight of the car based on 60 lb. cylinder pressure. All parts, however, are designed of sufficient strength to withstand a brake cylinder pressure of 80 lb.

Among other specialties used are type D couplers, Miner A-18-S friction draft gear, Farlow attachments and Imperial centering and uncoupling device.



40 Ton Coal Cars for the Chinese Government Railways

The Pekin-Mukden Line of the Chinese Government Railways has received recently from the Metropolitan Carriage, Wagon & Finance Company, Birmingham, England, several hundred gondola coal cars of 40 tons capacity. These cars are built of mild steel throughout with the exception of the underframes which are of Sandberg's high resistance steel—80,000 lb. to 90,000 lb. tensile strength—which made it possible to dispense with trussing and saved considerable dead weight. As the light weight is only 38,000 lb. the revenue load is 70 per cent. of the total, a good figure considering the size of the wheels.

These cars are 38 ft. long inside, 9 ft. 5 in. wide and 4 ft. 6 in. high, giving a capacity of 1,610 cu. ft. or 40 long tons. Two pressed steel side doors are provided on each side. The trucks are of the pressed steel type with 42½ in. steel-tired disc wheels, the truck wheel base being 6 ft. and the distance between centers of trucks 26 ft. The journals are 5 in. by 10 in. Semi-elliptic springs are mounted over the journal boxes.

The couplers are of the Janney automatic type that are fitted with India rubber springs. A hand brake of the screw type with shoes on all wheels can be operated from the end. Power brakes are not used.

Periodical Repacking of Journal Boxes

A Plea for Observance of the 12 Months' Requirement Removed from the Interchange Rules in 1921

By E. W. Hartough

THERE are very few roads that at some time have not had an epidemic of hot boxes. These epidemics affect the train service so seriously that every officer from the general manager down, becomes interested, with the result that a campaign is started all along the line to reduce the evil.

During these campaigns some car foremen resort to the old practice of applying free oil to every journal box, while others, to get around this prohibited practice, have a small piece of very oily packing placed alongside of each journal; still others do a little better by repacking every box that looks old and worn out. Thousands of bearings that are still good for long service, are removed and the stock of bearings is soon exhausted. At such times additional men are employed as oilers, but, having little experience in looking after such work, they are a menace rather than a help. Some car foremen try to lay the trouble to the new bearings they are receiving, to poor waste, or poor oil.

Every fair-minded man must admit that these periods of hot-box trouble are solely the result of continued neglect of the journal boxes. It is needless to describe in detail all the defects that produce a hot box; suffice it to say that the periodical repacking of the boxes will prevent these epidemics.

It is a well known fact among railroad men that, after long service, the packing that touches the journal becomes glazed and prevents enough oil getting to the journal to lubricate it properly, and it is reasonable to believe that when an oiler is over-rushed with work, the packing in every box is not properly stirred up. A close investigation will show that the packing in only a few boxes is stirred the full length of the journal, and that it is almost impossible to do this without repacking the box.

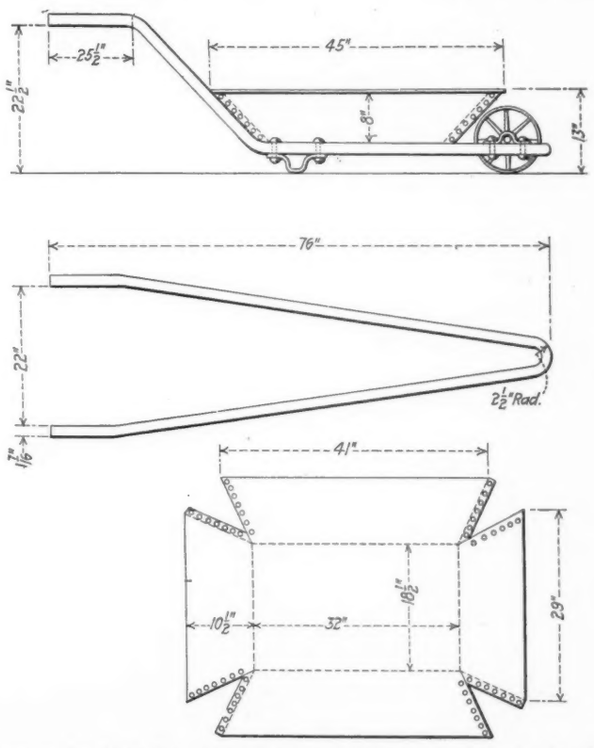
At first it was a difficult matter to get every road to consider the importance of repacking the boxes. At many places there were no renovating plants to take care of the old packing or to furnish enough of it to carry on the work. Through ignorance a great deal of the old packing was destroyed, and the foreman was censured for using so much oil and waste, but points with adequate means for renovating the packing found in a short time that it did not require as much new oil and waste as formerly. Experts in lubrication tell us that it requires months for waste to become thoroughly saturated with oil, and for this reason renovated packing contains more oil than new packing.

The packing of a journal box is exacting work. Every foreman should see to it personally that the men doing this work thoroughly understand how it should be done, and they should be held responsible for any failure caused by poor work. When a man is not properly instructed, he not only wastes a lot of packing but saturates his clothing with oil and soon acquires a dislike for the work.

The packing iron and hook should be of the standard size and pattern and made of the best steel, so that they will not bend when they are used to pry out the packing. The journal box packer should also be furnished a long narrow wheelbarrow with flaring sides, that can be run under any journal box. It should have room in one end for the old packing, at the same time holding sufficient renovated packing in the other end to fill the four boxes on one side of a car.

A strong and neat looking barrow can be constructed by using an old piece of 1¼-in. brake pipe for the handles, and riveting together several pieces of old car roofing for the body. Bearings for a standard 20-in. barrow wheel are riveted to the handles as shown in the drawing. To allow for all the bends in the pipe, the pipe should be 13 ft. long, and it should be bent before the holes are drilled in it for the axle clips, and the legs. The sheet for the body should be 39 in. wide by 52 in. long. The corners of the body are riveted together with seven 3/16-in. rivets in each corner, and the clips, legs and body are riveted to the handles. Wooden handles may be driven into the open ends of the pipe.

The renovating plant should have two wide doors with



Barrow for Handling Journal Box Packing to and from the Car

their thresholds level with the walk or runway, and so situated that the man returning with the old packing will not interfere with the man coming out of the plant with a supply of renovated packing. There should be an ample supply of the barrows so that the man tending the plant can have one loaded and ready every time another is returned. The tender should put the old packing in the renovating vats and he should load the barrows, because he should be the best judge of the quality of the material.

Little progress will be made if the packer is equipped with nothing but a bucket to hold the packing, and a light hook which will not withstand prying and requires a man to hook the packing out of the box a little at a time. This is discouraging and no one can keep even reasonably clean under such conditions.

Much can be said about stenciling cars that are repacked. The stencils should be made of tin or stiff fiber board and not

out of flimsy material. They should be made by a regular stencil cutter and not by the oilers; the brushes should not be those which have been discarded by the painters; clean white-lead should be used rather than a lot of skin or dried out paint—the refuse from the paint shop. The old stenciling should be painted out in time for it to dry so that the new stenciling can be placed on the same spot.

There has been a great deal of discussion about how many boxes an oiler should repack in a day of eight hours. Sometimes a man has averaged two cars an hour, but if 64 boxes have been repacked correctly, a very fair day's work has been done. Should a man repack only five or six cars a day the company will not be losing anything on his work.

It is impossible to estimate the saving that the former packing rule effected for the railroads. Where a road was having 50 to 100 hot boxes in 24 hours before this rule went into effect, the number has been reduced to 10 or 20 a day. When all the delays occasioned by having to set out cars with hot boxes is considered, together with the wear and tear on the equipment, it is evident that a substantial saving has been made by giving more attention to the repacking of the journal boxes. Someone has estimated that it costs $100 to stop a train of 75 or 100 cars and set out a bad-order car,—the majority on account of hot boxes. Stopping a train that is running 18 to 20 miles an hour and delaying it long enough to set out a car, couple the train together again, test the air-brakes, and accelerate it to 20 miles an hour, puts 3,000 or 4,000 tons of freight 10 or 20 miles behind. From 30,000 to 60,000 ton-miles has been lost to the railroad company.

The wear on from 600 to 800 brake shoes and an equal number of wheels is no trifle and the strain and wear on 200 draft gears is also an appreciable item. Every time a car is switched the body of the car is more or less racked,—it is a little nearer to being worn out than it was before. It costs money to compress air and every time the brakes are set unnecessarily there is a waste of air. When a bad-order car is set out some one must be sent from the nearest repair point to make the repairs. In some cases a train must make an unnecessary stop to let him off, and another train must stop to pick him up. A train must also stop to pick up the car after the repairs have been made. Then the delay to the car must be considered. When all these items are added there is no doubt but that in many cases the total cost of one hot box will be well over $100.

A certain percentage of wrecks are due directly to burned off journals, and if this percentage has been reduced by giving the journal boxes more attention it is a big point in favor of the packing rule. The amount of money lost in a few such wrecks would go a long way towards paying for repacking the boxes which might have prevented them, to say nothing about the possible injury or loss of life to the trainmen.

If every car passing over the repair tracks were repacked when needed the number of hot boxes could be further reduced. While some of the roads are still enthusiastically observing the requirements of the rule, others have lost their keenness and are not doing as well as formerly. It might be advisable to restore the charges for this work, but to put them under the head of "Delivering Line Defects." This would wake up some of the indifferent roads and cause them to do their share or pay for their neglect. At any rate the rule could be made to apply to the cars repaired on repair tracks. If the boxes were not repacked when due no bill could be rendered. This would not be too severe on anyone.

Doubtless many boxes will run longer than 12 months without repacking, although it does not pay to take the chance, as heretofore. Journal bearings are expensive, and their service can be materially lengthened by repacking every accessible box within the 12 months' period required in the 1920 rules. Not a single car on the repair tracks should be overlooked, as that is the best place to do the work.

When any box is found hot due to bad packing, every box on this car should be repacked.

The requirements of the rules that dust guards be renewed every time the wheels were changed, is not being lived up to and this results in hot boxes. This matter should be given more attention, because repacking a box with a worn dust guard will not insure its running a year without getting hot. Perfect lubrication cannot occur when the top of the packing is covered with dust soon after it is placed in the box. All missing or defective journal box lids should also be renewed.

It is remarkable how long car journals carrying heavy loads will run without heating. No other piece of machinery can compare with them. It is also remarkable how soon a journal can be burned off after it once starts heating. But journals will not run forever without attention and it is taking chances to run them more than a year without repacking. Whatever may have been the difficulties of enforcing it, there can be no argument as to the value of the 1920 rule with respect to the repacking of journal boxes. Disregarding a duty that is so important should not be tolerated.

Latest Design of Edwards Gasoline Motor Passenger Car

The Chicago, Burlington & Quincy has recently placed in service a gasoline motor car 32 ft. 7 in. long and weighing 19,000 lb. It contains a passenger compartment seating 39 and a baggage compartment in which there are folding seats for six additional passengers. It is driven by a 60-h.p. Kelly-Springfield motor.

High Points at Reading Locomotive Shops

Second Installment Giving Details of Modern Spring Shop, Hydraulic Press and Erecting Shop Work

Part II

DURING the Railroad Administration considerable difficulty was found in getting locomotive and tender springs and it was decided to build a small spring shop and install some modern spring-making machinery. Accordingly, an addition was made to the southwest corner of the blacksmith shop (see Fig. 1), providing a well-lighted room of ample size to handle the work. This spring shop was equipped with an R. D. Wood spring stripping machine, a banding and assembling machine of the same make, a home-made spring forming machine, necessary furnaces, oil baths, steam hammer, etc. Two jib cranes in conjunction with pneumatic hoists facilitate handling the heavy springs. A testing machine located in the stock shed is used to test the springs after being assembled. All Philadelphia & Reading locomotive and tank springs are now repaired at this point, the number handled annually being about 5,000. The stripping, assembling and testing machines are illustrated in Figs. 15, 16 and 17 respectively.

Fig. 15—R. D. Wood Hydraulic Machine Used for Stripping Springs

Springs as received are first put in the stripping machine (Fig. 15) when operation of the plunger, by means of the operating lever shown, quickly forces several of the leaves through the band and enables defective or broken leaves to be removed. New leaves of the proper section and length are then cut from new spring stock. After being heated in the furnace to a temperature of 1,200 deg. F., the leaves are taken out, given the proper camber and quenched in oil at about 900 deg. F. They are allowed to cool in the oil.

Both new and old spring leaves are assembled in the proper order on the assembling machine table (Fig. 16), operation of the control valve forcing out a plunger by means of air pressure in the cylinder at the right. This compresses the spring leaves holding them in position while the spring is revolved from the horizontal to the vertical plane and the heated spring band applied. The spring is then turned back to the horizontal position, air pressure being released and the band adjusted to the center of the spring. Both springs and band are then placed under the main portion of the machine when successive operation of the two main horizontal and vertical plungers compresses the heated band firmly

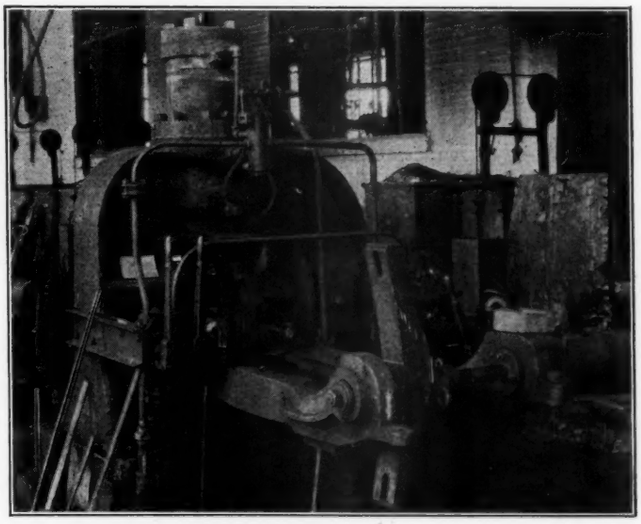


Fig. 16—Springs Are Assembled and Banded on This Machine

around the spring leaves in accordance with the usual practice.

A Riehle testing machine has been adapted to the testing of these springs as shown in Fig. 17. The capacity of the machine is 50,000 lb., springs being tested as follows: Take for example a 42-in. spring with 23 plates, made of ½-in. by 5-in. stock. This spring must carry 30,000 lb. at ¾-in. set. The height under 26,000 lb. is 13-7/16 in.; under 27,000 lb., 13⅜ in.; under 28,000 lb., 13-5/16 in., and under 30,000 lb., 13¼ in. The free height is 14 in. If a spring does not come up to these required specifications, it is sent

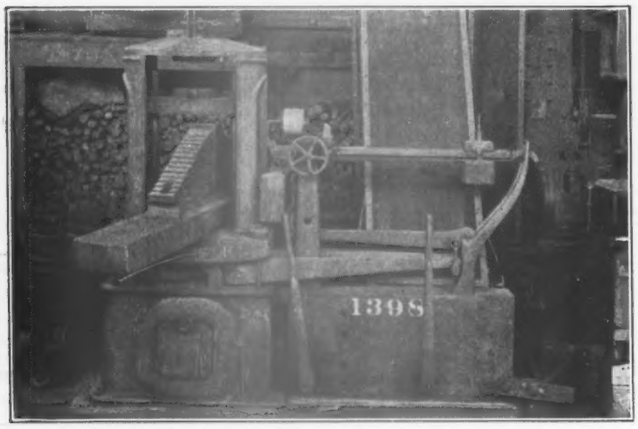


Fig. 17—Riehle Testing Machine Adapted for Springs

back for retempering. Coil springs are also made at this shop, the machine for shaping the coils being also home-made. One of the largest coil springs handled is that used in the expansion steam joint on Mallet locomotives, the spring being made from 1¼-in. stock. The diameter of the coil in this case is 18 in. and its free height 12 in.

Hydraulic Press Work in Boiler Shop

Obviously with the large amount of locomotive repair work centralized at Reading, it is necessary to have a large and well-equipped boiler shop. Perhaps the most distinctive feature of the boiler shop at Reading is the R. C. and W. H. Wood, 500-ton hydraulic press used for forming steam domes, flue sheets, throat sheets, door sheets, cylinder head casings, air reservoir heads and steel car parts, such as bolster center plates, draft arms, end sills, side sills, etc. Six men

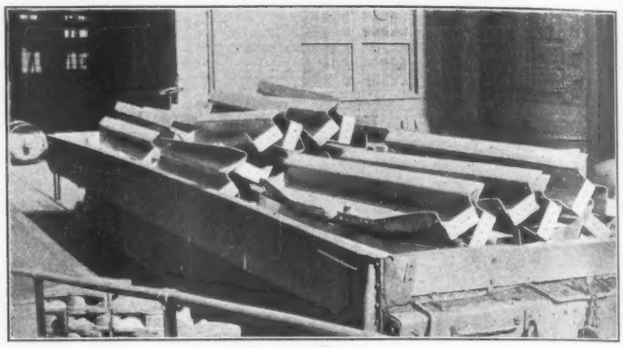


Fig. 18—Car of Steel End Sills Leaving Boiler Shop

are required for the efficient operation on this press. A complete set of dies has been developed for the work and wherever enough parts are to be formed, the dies are assembled in the press and the various operations carried through on a number of pieces of stock with very satisfactory results both as regards the quality and cost of the work. The location of the steel car shed within a comparatively short distance of the boiler shop is an important advantage as the heavy hydraulic press is particularly adapted to forming pressed steel shapes and not many steel car shops have such machines available.

A car of end sills, for example, is shown in Fig. 18 just leaving the boiler shop for the steel car shed. The dies for forming these sills are shown in Fig. 19 and their arrangement, assembled in the hydraulic press, in Fig. 20. These end sills are made of ¼-in. steel plate which is cut out to the proper size and shape and heated in a furnace adjacent to the press. With the flanging dies in the proper

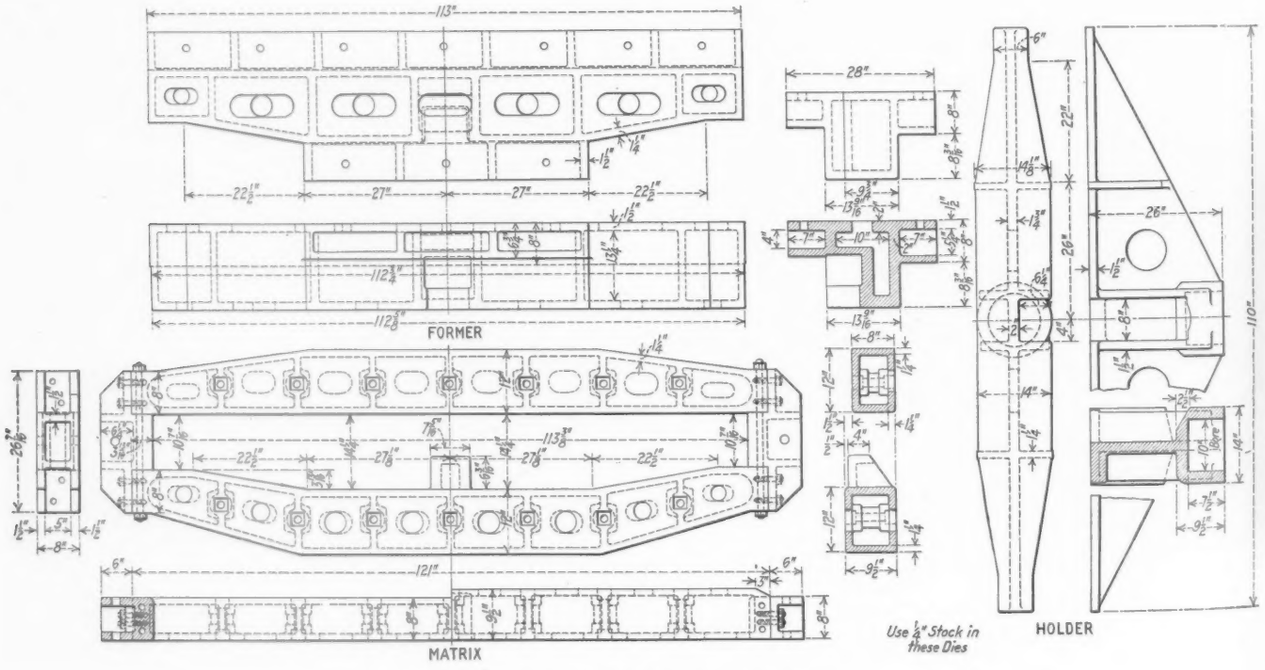


Fig. 19—End Sill Forming Dies

position each plate is then transferred to the press, properly alined, and one stroke of the press forms the entire sill with the exception of turning down the back flange. Referring to Fig. 20, the lower platen is the one which moves as the press is operated, the matrix and holder being firmly bolted to it. The former with its backing plate is solidly bolted to the top platen.

As in the case of most automatic and production machinery, this 500-ton press cannot be equipped with dies

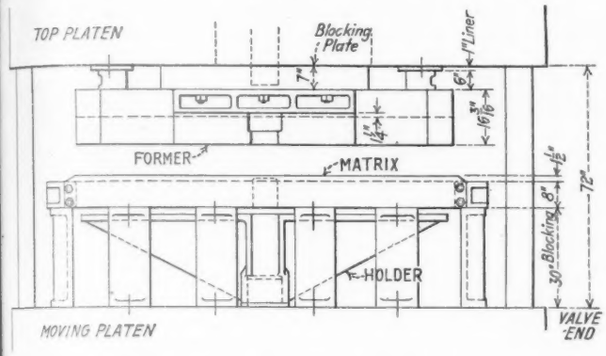


Fig. 20—Arrangement of Forming Dies in 500-Ton Hydraulic Press

properly alined without considerable effort and time spent on the operation. As a result, it would not pay to use the press for two or three parts. A certain number of parts must be made in order that the saving may balance the cost of setting up the dies. Any parts made in excess of that number represent an increasingly large profit.

Many other pressed steel parts besides end sills are made under this press, a group of smaller parts being shown in Fig. 21. These parts include diaphragms for steel car center sills, side stakes for low side gondola cars, protection plates, draft gear stops for steel cars and air reservoir heads. The press is one of the busiest tools in the Reading shops,

Fig. 21—Miscellaneous Small Pressed Steel Parts

so much so in fact that it is often difficult to get necessary straightening and other similar work done. Perhaps the most impressive work done under this hydraulic press is the manufacture of steam domes which, for one of the heavy class locomotives, are 23 in. high with a diameter of 31½ in. These domes are made of 1¼-in. stock, requiring five operations under the press.

Erecting Shop Work

Referring to Fig. 1, the method in which locomotives are turned on the two turntables and shifted into the respective erecting shops will be evident. Cranes are provided to move each locomotive to its permanent position while in the shop, with auxiliary cranes to handle the relatively lighter parts. A view looking down the east erecting shop is shown in Fig. 22. Each engine requiring heavy repairs is stripped of brake rigging, spring rigging, binders, etc., and unwheeled 10 hours after being received. Running boards, piping and small parts not requiring repairs are stored in covered pits between the engines. The wheeling and unwheeling gangs work on a second shift which saves almost two days in handling the locomotives. The motion work and parts are stripped and sent to the lye vat in the north end of the stock shed for cleaning. Driving wheels which are particularly dirty or those suspected of having cracks are also put in the big vats.

Special attention is paid to truing the pedestal faces and squaring frames at Reading as it is believed that the accuracy of this work has a big effect in reducing the number of broken frames and wheels developing sharp flanges. The driving box work and lining shoes and wedges also receive special attention. When ready to wheel, one of the heavy cranes lifts the locomotive and moves it out of the way while the driving wheels are being put in the correct position on the pit track by one of the lighter cranes. The locomotive is then moved back over the wheels and lowered into place. After being wheeled, the binders applied and the wedges set up, the wheel centers are trammed as a check on the accuracy of squaring shoes and wedges.

Each of the four erecting shop gangs has specialists to

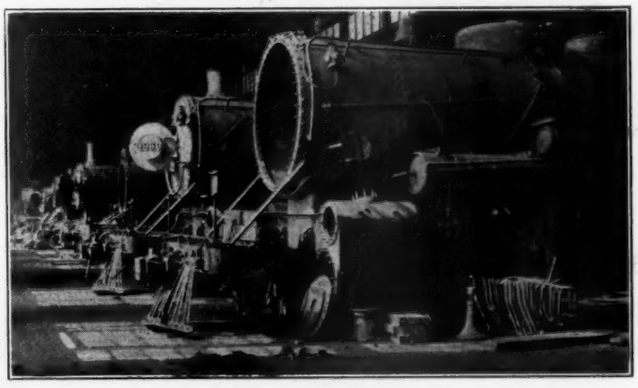


Fig. 22—Partial View of East Erecting Shop

handle particular phases of the work. For example, one man on each side of the shop is responsible for the cylinders. He inspects for cracks, calipers and bores the cylinders and valve chambers. Other men are available to help out when for any reason there are an unusually large number of cylinders to bore. All motion work and parts are returned to the engine 16 hours before it is due out. Weekly meetings enable the foremen to keep in touch with the progress of the work and decide on the locomotives going out in the ensuing week.

The general practice in welding frames at Reading is to use acetylene which has been done for a long period of time with few failures. Two hundred frames on Philadelphia & Reading locomotives have been acetylene welded with not over five failures out of the whole number. This work comes under the direction of G. L. Young, boiler shop foreman, who also furnished the photographs shown in Fig. 23 and the data on cylinder welding. As will be noted in Fig. 23, the cylinder and valve chamber were both broken to such a degree that repair by welding or any other method seemed hopeless. The following method of procedure, however, resulted in a successful weld.

The edges of the cylinder were beveled to 45 deg. and patterns of wood made, conforming to the parts removed. Patches were then cast, being beveled and fitted to the cylin-

der and held in position by a ring. A brick furnace was built around the cylinder and in order to give draft for preheating, the bottom row of bricks was spaced 1 in. apart, 6 in. being allowed between the furnace wall and the cylinder. About one half of a barrel of charcoal was placed in the furnace and when the charcoal was thoroughly lighted, more was added until half the cylinder was covered. Then a piece of asbestos was placed on top of the furnace with holes punched in it to give draft.

The cylinder was allowed to reach a dark red heat, enough brick then being removed from the front and side to allow the welders free access to the job. The welders began at the bottom of the V, fusing the bottom first, at the same time heating the sides and bringing them to a point of fusion. Cast-iron filler rods, ⅜ in. in diameter, were used, care being taken to raise all impurities to the top of the weld where they could be floated off. The weld was kept at a high temperature so the cooling process would not take place too fast. Just enough flux was used to dissolve impurities. After the weld was completed, the bricks were replaced in the openings, the furnace again filled with charcoal and left to burn out which required about 24 hours. When the fire was out the bricks were removed. The cylinder was then machined and made ready for service, the total saving over the cost of a new cylinder being estimated at $336.91.

This work was done by the oxyacetylene method. The material used was as follows: 2,021 cu. ft. of oxygen, 1,923 cu. ft. of acetylene, 225 lb. of cast-iron welding rods. Three operators were employed so they could relieve each other on account of the intense heat. The lower left corner of Fig. 23 shows one of the patches which was applied. This is considered one of the most difficult and incidentally most satisfactory cylinder welding jobs ever done in Reading shops.

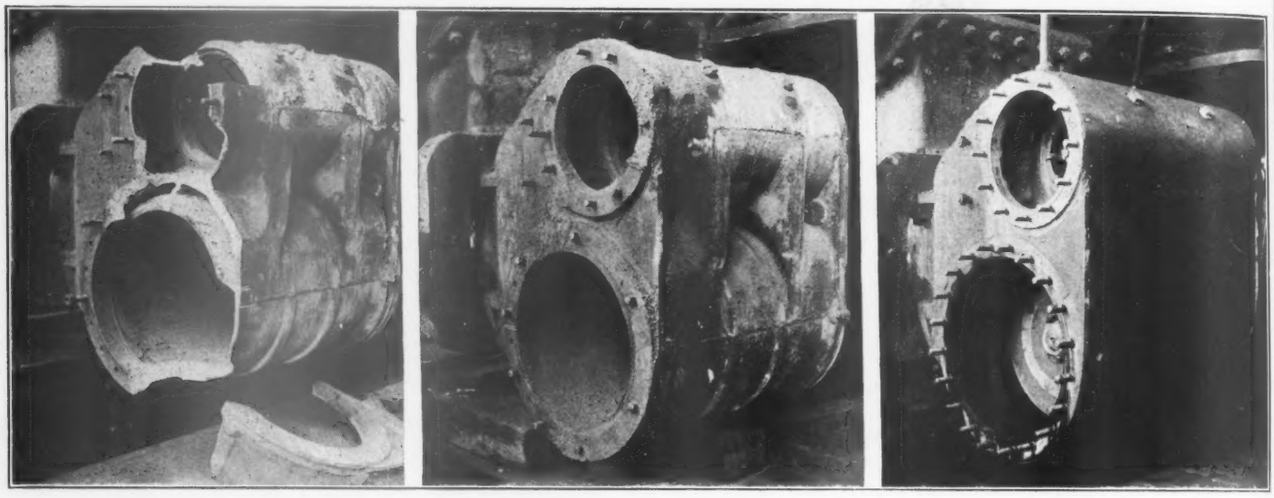


Fig. 23—Views of Cylinder Before and After Welding—Reading Shop Men Are Proud of This Job

Thirty-one of the locomotives owned by the Philadelphia & Reading are of the Mallet type. All these locomotives are being maintained at the Reading shops. This work is done in the north machine shop by a special gang which works in two eight-hour shifts. The Whiting hoist, illustrated in Fig. 24, is used for wheeling and unwheeling these locomotives, an operation which can be performed quickly and efficiently by this means. After the brake rigging, spring rigging and binders are down, the locomotive is simply hoisted high enough to allow the pony trucks and driving wheels to be run out underneath. The locomotive is then lowered on blocking and necessary repairs to the frame, cylinders and boiler are made while the driving wheels, boxes, rods and motion work are being cared for in the machine shop. It will be noted from Fig. 24 that the locomotive is lifted at six points of support by a six-jack hoist, enabling the Mallet type locomotive with its long wheel base to be handled.

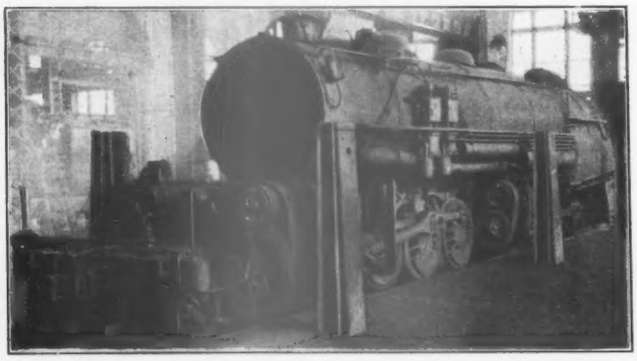


Fig. 24—Whiting Hoist Used for Wheeling and Unwheeling Mallet Locomotives

N. Y. C. Train 59 Near Syracuse, June 11

Practical Suggestions for Developing Foremen

Foremen Should Be Encouraged to Study Technical Articles, Visit Shops With Advanced Practices and Give Executive Duties Preference Over Desk Work

By an Ex-Foreman

THE spot light at the present time appears to be turned on the railway foreman. The foreman is a top sergeant of industry, sometimes exercising that authority and sometimes (it is to be regretted) bossed by his command. He must get equipment out on time no matter if material is not at hand. He must see that each man works industriously throughout working hours, needing several pairs of eyes for that purpose. He must attend to desk work, listen to grievances and settle disputes. He must be a practical machinist, boilermaker, blacksmith or car builder, an executive, a judge and a hustler. If he worked 24 hours a day, including Sundays and holidays, he could still find things needing his attention. The above description may be slightly overdrawn but it still holds much of truth.

With so many demands on his time, how can the foreman attend properly to executive duties? My advice is: Relieve the foreman of all possible work that detracts from his legitimate duties of supervising his department in an effective, economical manner. Give him a chance to plan better methods for doing the work. Educate him as to the best and most economical shop practices, encouraging the development of his own ideas. Send him out to other shops, not necessarily railway shops, but manufacturing plants where he can see advanced practices. As a general rule, manufacturers turn out work quicker and more economically than railway shops owing to the incentive of competition. From these outside shops many good points can be gathered and if a foreman can not absorb enough ideas on a trip to more than remunerate the railroad for his personal expenses, he is not a good observer.

Trained Foremen—A Vital Necessity

This article affords positive evidence that the author is an experienced railroad man and knows whereof he speaks.

He says that foremen are largely self-trained. Admitting the truth of this statement, we believe that railroad managements can and should do far more than they ever have to encourage and develop their supervisory officers.

Is there any practical reason why foremen should not be relieved of signing material slips, time cards and other details, devoting themselves to their real duties of supervising men? Read the author's suggestions.

Visit Up-to-Date Railroad and Industrial Shops

It is safe to say that practically every machine tool builder will extend the glad hand to visiting railway foremen. The value of the latter's visits consists not only in seeing machines that would be economical for railway shops, but more in seeing how the other fellow actually does the work and the general system in each shop. The manufacturer points out the good features of his machines and in turn profits by picking up little pointers concerning the special requirements for railway work. In each company special methods will be noticed which may impress the foreman as being adaptable to his work. For example, the writer once saw the operation of grinding crank shafts for automobiles direct from the rough drop forgings. This is not a railway job but, seeing it done by grinding was an eye opener and indicated the great possibilities of grinding.

In a motor truck factory the system of gaging and specializing was looked into. Motor trucks are not car or engine trucks, but looking into the general methods adopted by that company showed the possibilities for railway work. Some of these methods have been acted on and some are stored away in the brain for future use.

In a prominent toolmaker's catalogs will be found this notice: "We are always ready and glad to show our works to those who contemplate purchasing machinery or who are interested in machine shop or foundry practices." That company does not make railway equipment, but a demonstration of its methods of grinding, milling and measuring the various parts of its machines is an education in itself.

It must not be thought for a moment that, owing to the high grade of work turned out by industrial concerns, they have a monopoly of all the good workmen. *They appear to have the happy faculty of making a fair workman turn out first-class work.* This is a point worthy of study by all foremen.

Each railway shop will have certain points, tools and devices of special merit and probably a few antiquated methods. One caution should be observed. Don't let the visiting foreman go to the poorer shops as there is the possibility of his coming back very conceited and telling how much better work is done in the home shop. The management does not want to be told what it already knows. See that the foreman goes to the best railway or outside shop available.

Study Trade Papers and Technical Articles

In the line of education, trade papers and books on shop and railway subjects should be at the disposal of foremen. The costs will be repaid several times over. I would like to see a copy of the *Railway Mechanical Engineer* handed to each railway shop foreman every month. No one maintains that each reader from hostler foreman and car inspector to general foreman will find articles in each number written for his especial line of work, but certain articles will bear directly on the work of each and may be acted on at once or possibly later. On one occasion the writer read an article relating to a certain operation. About two years later conditions were such that this information could be used and as a result, the output of certain machines was doubled. One machine and man now turn out the same work as two by previous methods. That trade paper cost $3.00 per year and saved the company a like amount each four hours that the work was on the machine.

The duties of a foreman are principally to see that work is done in the most approved manner, on time and, if pos-

sible, a little better and cheaper than the other shop. He should see that each man attends to his duties and does an honest day's work, in addition showing the workmen by actual example, if necessary, how to do their work a little better and quicker. Don't think for a moment that most workmen will, in the long run, object to doing work quicker or better by an improved method, providing it can be done without extra effort on their part. In fact the American workman has a great amount of pride in doing good and speedy work and only needs to be shown where the methods may be improved. This is the opportunity of the foreman who has seen work turned out in the best shops and read trade papers. He will be in a position to tell and show the workman what are the greatest cutting speeds for the planer or lathe on each job; the feeds to be employed; speeds for drilling; how to grind a knuckle pin; how to avoid a lot of hand filing that only wears the man out so he can not work to good advantage during the latter part of the day; in fact, how to help the workman and not drive him. To do these things the foreman must be relieved from all extraneous duties.

Foremen Should Be Relieved of Details Such as Signing Material Requisitions and Time Slips

In line with this suggestion the question may be asked, "Why should the foreman make out or sign storehouse orders? Why are written orders from the shop necessary?" The goods handled by the stores department are all sold to one customer; i.e., the shop. The storehouse employee probably knows the material requirements as well as the foreman and should let a workman have a new crank or crosshead pin on verbal request, making a record for the necessary accounting and not bothering the foreman. The storehouse man will soon be in a position to tell as well as the foreman when workmen are drawing too much material. In fact it is a question if the workmen will abuse this privilege to any extent.

Railway shop material is largely special and not of enough value to be attractive or salable, especially when made from iron or steel. A workman will not steal crank pins or axles. He may take ten penny nails to mend the home fence but foremen's requisitions will not stop this practice among railway workers. Where giving out brass parts, files, hammers and other tools that could be disposed of at a profit, insist on the worn out part being returned, or in the event of additional parts, the storekeeper can keep an eye on the requirements. In other words, the storekeeper should keep the shop supplied and not bother the foreman to look after what are really the storekeeper's duties.

Why should the foreman be required to certify to the time of each man and job? In most manufacturing concerns this is done by the time clock. A clerk at the foreman's desk makes out the necessary order cards for the week. When a job is started, the order card is punched in the time clock. When completed, the order is again punched, the elapsed time showing all that is desired for ordinary purposes for either day work or piece work. This in any shop will relieve the foreman of a large amount of routine work. The argument may be advanced that the foreman should go over all time or order cards to see that charges are correct. The question is: Where can the foreman best observe the time for any particular job? He can sit down at his desk and finger over several hundred cards, tax his memory and rack his brain as to what should have been the proper time or charges, or he can try to remember previous costs and, should the time or cost look excessive, get after the workmen and raise a row after the damage is done. If relieved of routine details, however, he can spend most of the time about his department seeing that the workmen are on their jobs and preventing too much lost time or excessive costs before they occur. Plainly the latter is the more desirable plan.

Certain articles made in railway shops may be classed as manufactured material, such as bolts, forgings, crosshead pins, etc. These are generally made on shop orders, the cost being computed by the accounting department. The foreman is always interested in these costs. Why should not the cost of all these articles be made up monthly, also the costs for previous months, and given to the foreman? Should the costs of any particular article go up, he will naturally look for the reason and try to apply a remedy. If able to reduce costs on the next job, he will be pleased and have an incentive for more reductions, especially when given encouragement from higher up. Many a dollar has been saved in railway shops by showing comparative costs, by a few complimentary words, and by one department in friendly rivalry with other departments.

Foremen Are Largely Self-Trained

The master mechanic or general foreman is generally too busy to spend much time training foremen and, unfortunately, it is generally up to each foreman to train himself. This takes time. A man can not be expected to step right out from his lathe or bench and become a first-class gang foreman, jump up the ladder to assistant foreman and then give another spring to a full-fledged foreman without an apprenticeship in each of these places.

When starting in a new gang foreman, he should be coached by his superiors in the best methods of getting out work, keeping what shop records are necessary and maintaining discipline. In addition he should make an occasional visit to other shops. The gang foreman, as a raw recruit when visiting other shops, should be requested to make written reports on what he may see in order to ascertain what kind of an observer he is and if he has the ability to detect quickly shop operations that may be of value. A man who is quick to detect a good device for turning out work will generally develop into a valuable man in the way of introducing labor-saving devices. In order to have a check, it is advisable to have him go to a shop well understood by the home management so that his ability to observe and absorb good points may be judged. The new gang foreman should also have access to literature on shop subjects as mentioned above. The foreman should coach his assistants, point out articles that are of interest, have him read and also explain them. This is a good way to find out if the new man understands an article.

Lectures at Foremen's Meetings Helpful

A large amount of good may be done by getting the shop foreman and assistants together and listening to short talks on shop subjects. These talks may be by one of the shop organization or by experts from outside. A number of concerns, manufacturing machine tools, shop appliances and general railway supplies, have in their organizations good speakers who will give lectures on subjects relating to their products. The writer has listened to several lectures or, more properly speaking, informal talks by these people. The agreeable surprise was the fund of information given concerning their shop operations which was adaptable to railroad shop work. Much good can result from talks of this nature.

The shop foreman as a general rule graduates from grade or high school and shop apprenticeship courses. His chances for higher education along mechanical or supervisory lines are slim except in the college of hard knocks. He is generally tied up in one location and, without seizing the opportunity to broaden out by reading technical papers and visiting other shops, the chances are that he will cut but a narrow swath. It should be remembered that the foreman directs the spending of many a dollar. His proper training and development are vital to the best interests of himself and the railroad which employs him.

Pneumatic Power and Transmission Losses

A Detailed Study of Methods for Locating and Stopping Air Losses Common in Railroad Shops and Yards

By B. C. Bertram
General Locomotive Inspector, Erie, Youngstown, Ohio

COMPRESSED air is a power medium virtually inseparable from railroad and industrial shop operation. A limited knowledge of thermodynamics, however, has prevented in some instances a correct understanding of the cost of compressed air and the necessity for rigid economy in its consumption. Authorities on the subject differ considerably as to the actual cost of coal and water consumed in compressing air. Estimates range from three to five cents per 1,000 cu. ft. compressed to 100 lb. per sq. in. The computations in this article are based upon the conservative basis of three cents per 1,000 cu. ft. of free air compressed.

On account of its peculiar adaptability, the use of compressed air as a power medium has been widely extended and it is, in fact, practically indispensable for the operation of riveting hammers, rivet breakers, flue welders, forming machines, testing devices and various other machines usually found in railroad shops. The result is that air lines are being constantly extended and air-consuming appliances added, often without consideration of compressor capacity.

With the extension of air lines and added appurtenances, the possibility of leakage and transmission losses are increased and this article undertakes to point out some of the losses resulting from defective air lines, hose, tools and other equipment, based on exhaustive tests and an intensive study of the applications of compresed air power in railroad shops.

Monetary losses resulting from air leakage, illegitimate uses of compressed air and carrying an insufficient pressure on the shop lines are astounding, and yet it is a matter which is seldom given serious consideration. Of these three conditions the latter, no doubt, occasions the greatest loss since it affects production directly; that is to say, the efficiency of all air tools generally varies directly with the pressure of the air which operates them, most tools being designed to operate with 100 lb. pressure.

In this article are selected from wide and varied experiences five concrete examples of air losses, representative of many that may be found in railroad shops throughout the country. While these losses may be exceptional in some phases, on the whole it is safe to say that parallel cases may be found in a great many other railroad shops.

Air Losses in Large Terminal Yard

No. 1. The first case deals with a condition which arose in a large terminal yard where switch operations were being seriously hindered. Trains were frequently delayed on account of insufficient air presure, preventing successful operation of the electro-pneumatic switches and making it necessary to bar the switches over by hand. A peculiar condition in the case was that, although an average pressure of approximately 112 lb. was being constantly maintained at the point of compression, the pressure at the terminal tower located 1,500 ft. from the compressors ranged as low as 60 lb., the variations of pressure at the terminal tower bearing no relation to the pressure maintained at the compressors.

The fact that it was possible to maintain a constant and adequate pressure at the point of compression gave positive assurance that the trouble was in the transmission lines. This being established the problem of locating the trouble was rather a difficult one on account of the air lines being underground from two to five feet. Air gages were placed on the line at several different places between the compressor room and the terminal tower and, by special arrangements, readings were taken simultaneously at these different points covering a period of two hours. From the readings, by noting the amount of drop in pressure between the different points where gages were located and by isolating certain sections of the line, it was possible to locate the largest leaks. The record of the test and explanation of locations are shown in Table I:

TABLE I—PRESSURE DROP BETWEEN COMPRESSOR AND TERMINAL TOWER BEFORE LEAKS WERE STOPPED

Time	Pressure in Pounds at Location							Total Drop
	No. 1	No. 2	No. 3	No. 4	No. 5	No. 6	No. 7	
2:00 p. m.	80	84	84	87	88	104	112	32
2:10 p. m.	82	85	85	86	88	107	112	27
2:20 p. m.	80	84	84	86	88	106	115	25
2:30 p. m.	80	84	83	87	88	104	111	31
2:40 p. m.	80	80	82	86	88	104	110	25
2:50 p. m.	80	82	82	86	88	105	113	33
3:00 p. m.	79	80	79	82	85	97	109	26
3:10 p. m.	74	75	75	78	80	96	109	28
3:20 p. m.	73	75	76	78	80	95	111	28
3:30 p. m.	75	75	77	80	81	97	110	27
3:40 p. m.	75	75	77	78	81	96	109	31
3:50 p. m.	75	75	77	80	81	97	110	29
4:00 p. m.	75	76	77	80	81	96	110	28
Average	78.4	79	79.7	80.2	84.4	99.8	111	28.8

Explanation of Locations:
Location No. 1—At terminal tower, about 1,600 ft. from compressor.
Location No. 2—Opposite tower, 1,500 ft. from compressor.
Location No. 3—200 ft. east of tower or 1,700 ft. from compressor.
Location No. 4—On second line 1,100 ft. from the compressor.
Location No. 5—On second line 800 ft. from the compressor.
Location No. 6—On second line 300 ft. from the compressor.
Location No. 7—At compressor.

Referring to Table I it will be noted that the drop in pressure between the compressor and the terminal tower averaged 28.8 lb. The test was made during periods of minimum consumption, which is responsible for the pressure being higher at the terminal tower than during rush hours or at a time of maximum consumption. It will also be noted that the greatest drop in pressure occurred between Locations 5 and 6 and between Locations 6 and 7.

The facts shown by this test resulted in several sections of pipe being uncovered and examined, revealing a deplorable state of deterioration, the pipe having been in the ground for approximately nine years subject to the chemical action of the cinders in which it was embedded. The ultimate result was that all cross lines in the entire yards were renewed. It has now been several months since this work was completed and air troubles are a thing of the past. Figs. 1 and 2 are submitted to show the pressures at air compressors and terminal tower, respectively, before and after these leaks in the transmission line were located and stopped.

From Fig. 2 it will be noted that the pressure at the terminal tower is practically equalized with that at the compressor room and any variation in pressure is noticeable on both charts. The prime object of making these tests and repairs was to eliminate the trouble experienced in switch operation, but by accomplishing this the economy

effected is worthy also of serious consideration and the following data will no doubt prove interesting:

Average air consumption each 24 hr. day before repairs...	1,291,832 cu. ft.
Average amount of air consumed each 24 hr. day after repairs..	841,085 cu. ft.
Average amount of air conserved each 24 hr. day after repairs,.	450,747 cu. ft.
Average amount of air conserved in one year	151,022,655 cu. ft.
Percentage of capacity of compressors used before repairs...	69-2/5 per cent
Percentage of capacity of compressors used after repairs....	47-4/5 per cent
Cost of coal and water used in compressing 450,747 cu. ft. of air per day	$13.52
Economy effected in one year	$4,934.80

It is obvious there were other economies derived from the decrease in the speed of the compressors such as less lubrication, less wear, less coal handling, etc. The overhead charges, not being materially changed.

Shop and Steel Car Yard Losses Reduced

No. 2. It has been found that in shops with an abundance of compressor capacity, the tendency is to be extravagant in the use of air; that is, *where no trouble is experienced from lack of air pressure very little attention is paid to ordinary air leaks,* unless, of course, they should assume alarming proportions. The second case referred to is one where this condition applied.

In this particular shop were located a 1,250 and a 2,500 cu. ft. capacity air compressor. A pressure of 100 lb. was maintained, but with some difficulty, it being necessary to run both compressors night and day. During periods of maximum consumption the compressors were run at their maximum speed, the power plant being sorely taxed to furnish sufficient boiler capacity.

In these shops and car yards were found hundreds of air line leaks besides 130 defective air hose, all of which

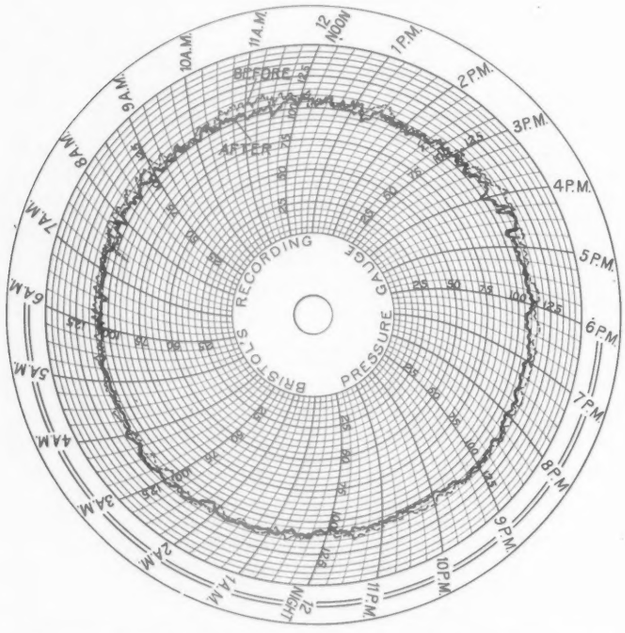


Fig. 1—Recording Chart Showing Final Stage Air Pressures at Compressor Room

were repaired as soon as the work could be accomplished. The result was that one compressor was able to furnish sufficient air, the large compressor being run days and the smaller one nights. Moreover, one boiler was cut out and the program for additional boiler capacity then under advisement was taken off the slate.

The economy effected in this instance was not derived from increased production since there was in the first place no lack of air pressure, but was derived from the economy in coal and water.

The following figures were compiled from the data taken during the tests made at that time:

Average pressure maintained before repairs	100.03 lb.
Average pressure maintained after repairs	101.27 lb.
Average air consumption in each 24 hr. day before repairs.	1,334,502 cu. ft.
Average air consumption in each 24 hr. day after repairs..	1,068,552 cu. ft.
Average air consumption in each 24 hr. day after repairs.	265,950 cu. ft.
Amount of air conserved in one year	97,071,750 cu. ft.
Cost of coal and water in compressing 265,950 cu. ft. of air a day	$7.98
Economy in coal and water per year	$2,912.70

There were, of course, other economies effected by eliminating the operation of one compressor and one boiler which it has been difficult to capitalize in dollars and cents.

No. 3. The third proposition deals with a situation where a large steel car yard was experiencing serious trouble

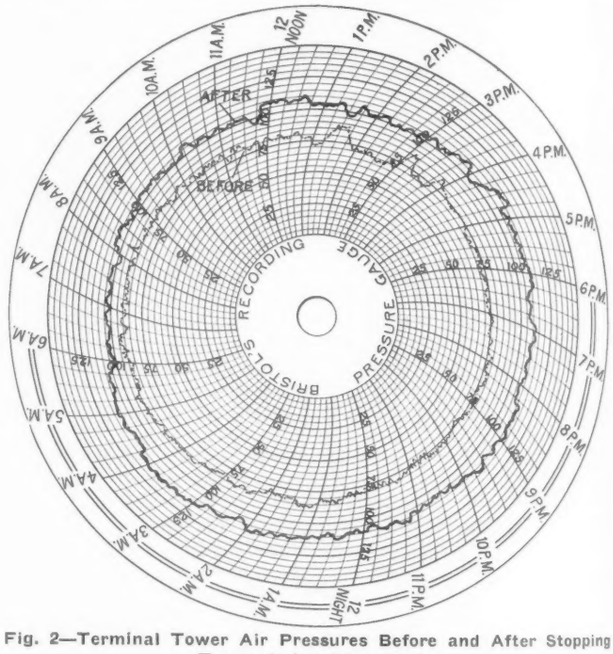


Fig. 2—Terminal Tower Air Pressures Before and After Stopping Transmission Line Leaks

from insufficient air pressure, which ranged only from 40 to 60 lb.

Investigation developed that there were several bad leaks in the air lines, etc., but the principal trouble was due to serious defects in the air compressor, necessitating extensive repairs. After the various defects were remedied, the maximum pressure of 100 lb. was easily maintained and with a slower speed of the compressor. The increased pressure was directly responsible for the immediate increase in production of five cars a day without any additional expense to the railroad.

It would be quite difficult to capitalize the real and entire economies effected by this increase in air pressure, but it is obvious that it would greatly eclipse the savings set forth in the two previous cases where the principal economy was derived from the savings in air consumption.

No. 4. Great economy was effected in a shop at another point where low air pressure was causing endless trouble. In this particular situation one large air compressor furnished air to the back shops, roundhouse and steel car yard.

A test made at the time showed the following interesting and instructive results: All air-using tools and facilities were put in operation simultaneously. At once the pressure dropped to zero as far as practical efficiency was concerned. Analysis of air-using facilities resolved them into two general groups. One included those used in regular daily routine of operations; the other, those that were in the nature of occasionally used facilities, including unloading fuel oil, elevating sand, sand blasting, setting tires and welding flues. In the latter group, while properly belonging in Group 1, were included several air-using furnaces in the car yard.

Analysis of demand developed that a pressure of from 90

to 100 lb. could be maintained when using all the facilities of Group 1 to capacity; operating in addition any one of the facilities named in Group 2 immediately brought the pressure down to about 70 lb.; operating any two of them brought the pressure down to 50 lb. or less; and using any three of them in addition to the daily routine facilities brought the efficiency of the whole operation practically to zero.

By special arrangement with the shop supervision a very conclusive and interesting test was made after the necessary extensive repairs had been accomplished, a constant pressure of 100 lb. being easily maintained.

By carefully prearranged plans, at a certain time in the day every available air-consuming device in the shops and car yard was put into service simultaneously using the maximum amount of air. This included tire setting, sand blasting and, in fact, all operations included in Groups 1 and 2. Throughout this test a pressure of 94 lb. was maintained. This is significant since it is obvious that the existing conditions during the test would never be paralleled in every day practice.

In addition to the increased efficiency which resulted, the management worked out a schedule whereby certain operations, such as elevating sand, unloading fuel oil, etc., was done during periods of minimum load. This arrangement added materially to the successful operation of the plant. The resulting increase in production in this plant saved thousands of dollars a year.

No. 5. Perhaps the greatest saving effected in any shop was in the case where, due to an erroneous opinion, it was thought that the compressors were no longer able to supply an adequate air pressure and for this reason five booster pumps were installed, four in the boiler shop and one in the tank shop.

Air was taken from the shop line at 65 or 70 lb. pressure and boosted by the air of five 9½-in. Westinghouse air compressors to 100 lb. It developed that after all the defective lines and other leaks about the shop had been repaired and necessary repairs made to the compressor the compressor could easily maintain the requisite 100 lb. pressure, the booster pumps being discontinued. It has now been over two years since this took place and the booster pumps have long since been taken out of the shop.

Tests show that it costs about $5.40 each eight-hour day to operate a 9½-in. air pump. It is obvious, therefore, that in this instance a saving was effected of $27.00 a day, or $8,262.00 a year, figured on the basis of 306 working days. It will be found in the majority of instances where booster pumps are employed that if exact and systematic methods be employed in stopping air leakage and illegitimate uses of compressed air, the compressor will be capable of maintaining the desired pressure.

Illegitimate and Extravagant Uses of Air

The subject of the illegitimate and extravagant uses of compressed air is one on which volumes could be written and space would not permit the recording of all the bad practice seen daily in railroad shops throughout the country. However, a few of the more common abuses follow:

An instance was noted in a large power house where one man was employed almost constantly scaling the inside of the drums of a battery of water tube boilers. It was necessary to have some means of keeping the atmosphere inside the drums cool. To accomplish this a ½-in. air hose directed a constant jet of compressed air through the manhole in the end of the drum. Investigation developed that the amount of air consumed in an eight-hour day cost in coal alone $5.92 and that the same results could have been obtained with a 16-in. electric fan at a cost of $.096.

At another point it was noted that an engineman in the roundhouse took occasion to blow off the jacket, running boards and cab floor of his engine with compressed air, a more or less common practice to which little attention is ever paid. In the four minutes air was being used in this operation, 764 cu. ft. were consumed, or about 12 per cent of the capacity of the compressor. As it happened, this particular shop was suffering from a lack of sufficient air pressure.

In another shop an air blower was used in firing up locomotives for the trial trips. Approximately 61,800 cu. ft. of air were consumed each time an engine was fired up. Further investigation developed that within 20 ft. of the air valve where the house was connected, there was a live steam line and the change was made at once to the steam blower.

Frequently air engines are employed to perform work which could be acomplished from the shop line shaft. All kinds of contrivances have been made from steam cylinders of 9½-in. Westinghouse pumps, consuming thousands of cubic feet of air a day at an enormous expense to the railroad company.

Electric motors, running warm, have been found with an air hose playing a constant jet of air on them to keep them cool. Electric welded parts are sometimes cooled off with air in order to machine them quickly. This is accomplished but often at the expense of ineffective air tools, due to decreased shop air pressure.

It should also be remembered that whenever the safety valve on an air receiver is heard blowing, it means just so much money wasted. This is something which can

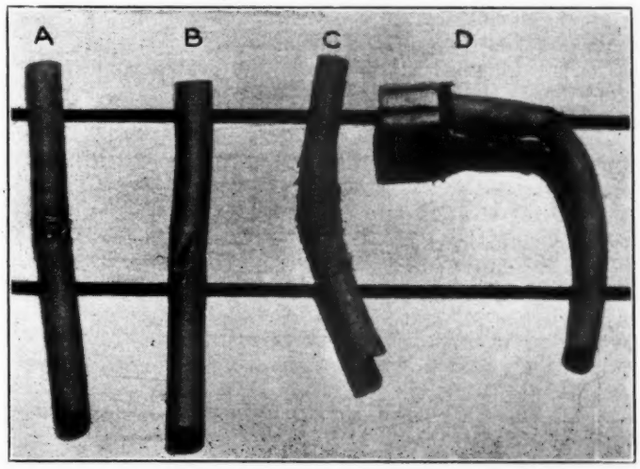


Fig. 3—Four Common Examples of Defective Air Hose

be observed daily in nearly every railroad shop in the country, especially during the lunch hour.

The use of open air jets instead of vacuum cleaners for cleaning carpets and cushions in car yards, air jets for blowing scale off hot iron which is being drawn out under steam hammers, air jets on emery wheels, etc., are all expensive practices. Air jets are not designed for cleaning the floor or blowing dust off clothing. The use of compressed air in furnaces and forges where a fan blower could be utilized should not be tolerated.

Chips are also often blown off machine tools using compressed air. This practice should be forbidden since it not only wastes the air, but often blows chips into oil holes causing bearings to start cutting.

Defective Air Hose a Source of Great Loss

A large proportion of the waste of air in shops is usually caused by carelessness on the part of the workmen in making hose connections. In many shops an active campaign has been conducted to educate the workmen along this line. Also, the practice of wrapping air hose in an endeavor to stop a leak should never be attempted since usually the sound of the escaping air is only muffled and the actual

leak still exists. Numerous hose have been wrapped with tape, string, wire, rope, burlap, pieces of handkerchiefs and, in fact, an endless variety of things in an effort to stop the leaks.

In some shops water hose is being used for air. This hose is not designed to carry the heavy presure and no end of trouble results. A three-ply hose is best adapted for air pressures up to 100 lb. Fig. 3 shows sections taken from defective air hose, and defects of this nature are very common. Specimen A, Fig. 3, is one which was wrapped with a copper wire in an effort to compress the fracture in the hose. This wrapping stopped considerable of the leakage but compressed the hose to such an extent that the flow of air was greatly restricted, seriously affecting the efficiency of the air motor.

Specimen *B* in the photograph shows a fractured hose with a wrapping of string removed. The leak in this hose was not overcome by the wrapping but the sound of the escaping air was somewhat muffled as is usually the case in wrappings of this kind. Specimen *C* indicates the usual wrapping of adhesive tape, which is no doubt the most effective of any wrapping. Even with this method, however, the leak is only stopped temporarily since the air pressure soon forces itself between the hose and the tape and while the leakage is distributed between the layers of tape and is not so noticeable, the fact still remains that the loss of air is usually just as great.

Any effort to overcome a leak in an air hose by exterior wrapping is just as ineffective and impractical as putting a blow-out patch on the exterior of an automobile tire. The reason for this is that the rubber is flexible and the air pressure passes through the fracture, forcing its way between the hose and the wrapping by compressing the hose and escaping at the end of the wrapping.

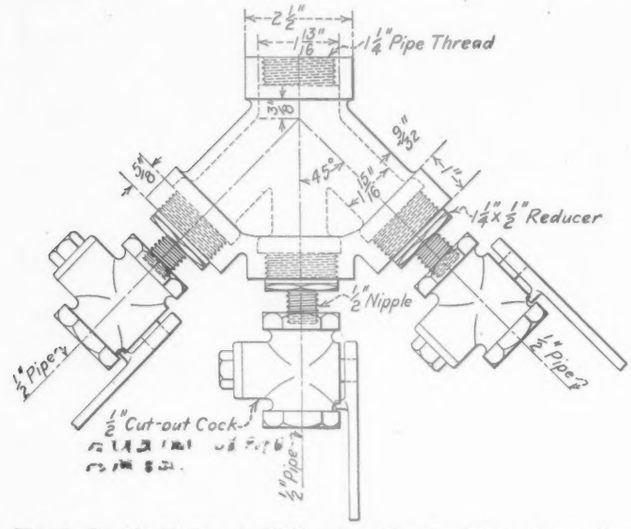


Fig. 4—Double Y Branch Fitting Provides for Three Connections and Prevents Kinking the Hose

It was also found that in the majority of shops the cut-out cocks to which hose were connected usually were arranged horizontally, causing the hose to bend sharply just at the end of the inserted nipple. This abuse, illustrated at *D*, Fig. 3, usually causes a fracture of the fabrics at that point and it has been found much more satisfactory to have hose connections in a vertical position or at an angle of 45 deg. so that the hose will hang straight down or assume a long, gradual curve to the floor.

A double Y branch fitting (Fig. 4) shows an ideal arrangement when fitted up with three ½-in. cut-out cocks. This permits of three hose connections feeding from one main without restricting the flow of air or interfering with the efficiency of the air appurtenances.

In many railroad shops and roundhouses workmen are allowed to retain the air hose in their tool boxes indefinitely. Where this is the practice it has been found that invariably, for lack of periodical and systematic inspection, the hose are in bad shape. Due to indifference or a feeling on the part of the workman that he prefers his own hose, he hesitates to exchange it at the toolroom for another when it develops a defect and this is responsible for the wrapping, etc. It has been found good practice to have the hose returned to the toolroom when not in use or turned in for inspection at least once a week.

Other abuses of air hose consist of allowing them to remain about the floor when not in service, one end being usually attached to a cut-out cock. This condition has frequently been noted in boiler shops particularly, trucks being run over the hose and boiler sheets, scaffolding and other heavy material falling or resting upon them.

Test Air Lines Periodically for Leakage

A periodical inspection of air lines is most essential. Leaks in back shop air lines can usually be detected when machinery is not running and the shop is quiet. It is difficult, however, to detect leaks in the overhead lines in the roundhouse due to the usual noises of the blowers and escaping steam. The chemical action of the gases and condensed steam cause these lines to deteriorate very rapidly and frequent and careful inspection is necessary.

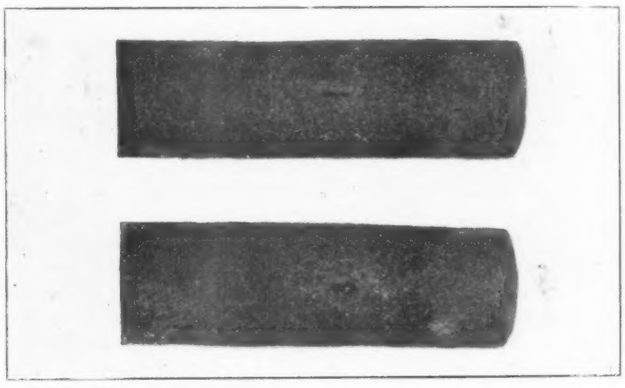


Fig. 5—Examples of Corrosion in 3-In. Overhead Air Line in Roundhouse

Air should be shut off from sections of the shops where it is not required and from all the shop lines at night or days when shops are not operating. Valves should be installed in suitable locations, so that different sections of the shop can be isolated to facilitate repairing the air lines.

Outside lines should, if possible, be kept above ground. It is frequently found that air lines are buried from six inches to three feet deep, making inspection practically impossible, and specific instances have been known where leaks of such a magnitude as to practically tie up the shops for air were unnoticeable from the surface of the ground.

Where necessary in car or terminal yards to run pipes under the tracks, it has been found good practice to have them boxed in, the top of the box being level with the surface of the ground. The box also protects the pipes, preventing to a great extent detrimental chemical action due to cinders. Exposed lines should be equipped with sufficient expansion joints to allow for the expansion and contraction, usually spaced 300 ft. apart.

In the inspection of air lines the magnitude of some of the defects discovered have been startling. Fig. 5 shows holes in a 3-in. overhead roundhouse line, responsible for thousands of cubic feet of air being wasted each day. This particular line carried an air pressure 24 hours a day. (*This article will be continued next month with a discussion of compressor losses in power plants.*)

Principles of Oxyacetylene Fusion Welding Part 5—Welding Cast Iron, Continued

By Alfred S. Kinsey*

AFTER making welds in cast iron, as described in this article last month, the next step is to determine if the welds have been made as nearly perfect as possible. This is especially important in some cases where the welds are subjected to more or less severe stress in service.

14. *Examination of Weld.*—After a cast iron weld is completed and cold, if it is of much importance it should be examined for porousness and other defects. It should not be assumed that because the joint has been reinforced all has been done that is possible to insure a good strong weld. After the metal is cold the surface of the weld might be chipped with an air chisel or hand chisel sufficiently deep to remove the thin harder surface here and there over the weld. This will lay bare the upper metal of the weld and expose any porousness or blow-holes which may have developed. If such defects are found they may be due to the following: (a) Too liberal use of flux. (b) Not enough puddling of the molten metal with the welding rod. (c) Improper adjustment of the torch flame. (d) Allowing the weld to cool too quickly. A good welder can avoid all of these weaknesses. If the weld contains blow-holes or shows general porousness, the surface should be chipped deeper until good homogeneous metal is found, and then the joint should be rewelded. If the defects appear to go entirely through the joint the whole weld should be chipped out, and the job done over with greater care. The weld should also be examined for small shrinkage cracks both in the joint and particularly adjacent to the weld on both sides. These cracks may not be due to welding at all. They may have been caused at the foundry when the casting was made, by improper cooling, poor venting of the sand mold, improper ramming of the sand, poor mixing of the metal in the cupola, improper balancing of the chemical elements, carbon, silicon, manganese, phosphorus and sulphur, or from some other cause. Sometimes these cracks will not show on the surface until the casting is heated red hot a long time afterwards, as in welding, and then they are often charged to the welder. Sometimes too hasty cooling in the foundry when the casting was made, may set up strains in it which later will be developed into cracks by the vibrations forced through the casting in its use as would be caused, for example, by a locomotive in its cast iron cylinders as they are continually jarred in service. If the iron casting to be welded is hollow and it is possible to temporarily seal its openings, a good way to locate porousness, blow-holes or small cracks is to put an air pressure in the casting and then brush soap water over the surface to be tested. Any leakage will show as soap bubbles. The air pressure should be about the same as the working pressure on the casting. In the inspection of welds a small magnifying glass, say of from 5 to 10 powers, will be found of valuable assistance. The glass may be purchased in an optical supply store, and is not expensive.

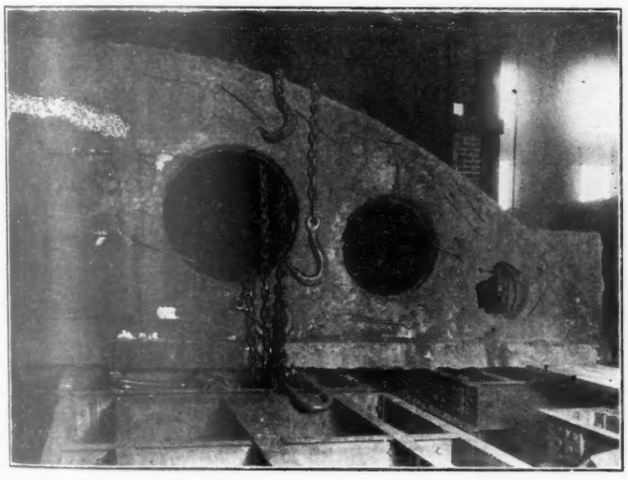


Fig. 1—A Typical Iron Casting Welded by the Oxyacetylene Torch

The Making of an Iron Casting

In order that an oxyacetylene welder may better understand the principles governing the making of a successful fusion weld of cast iron, if he is not familiar with foundry practice it will be of assistance to describe the casting of iron and the general properties of the metal.

Iron ore as taken from the mine is the source of the base metal for all the irons and steels of commerce. The ore is in the form of iron oxide; that is, the iron is saturated with oxygen, and in turn this iron oxide is intermixed with what is called the gangue consisting of silica, clay or lime-rock. Therefore two things must be accomplished to produce a good commercial metallic iron; i.e., remove the oxygen from the iron oxide and separate the silica, clay or lime-rock from the iron. It will be well to note that as iron comes to us saturated with oxygen, even though the oxygen is removed to make the iron useful, there is always a tendency of the iron to absorb oxygen (rust) and return to its original state as iron oxide.

The common method used to remove the impurities of iron ore is to put it in a big smelting furnace and melt it with coke or anthracite coal. The fuel contains a large percentage of carbon which on burning unites with the oxygen and burns it out of the ore. Then the gangue melts, floats to the top and is removed at the back of the furnace as slag. The pure metal is tapped from the front of the furnace and run into molds called pigs to solidify. These chunks of iron then are known as pig iron, and they are used for the manufacture of all irons and steels. Pig iron is made in five grades, dark gray, medium gray, light gray, mottled and white iron. The dark gray is the softest and most costly, while the white iron is the hardest and cheapest.

Now let us go from the ore smelting plant to the iron foundry. To make an iron casting the pig iron is thrown into a big vertical furnace in the foundry, called the Cupola, where it is melted by coke. It then is tapped from the cupola, run into a ladle and thus carried to and poured into the mold of the desired casting. This might seem to be a simple operation, but quite to the contrary, iron founding is one of the most difficult of trades (Fig. 1).

To make a good iron casting a pattern is necessary, which is usually constructed of wood. This pattern is then placed either in a wooden or iron flask or down in the sand floor of the foundry. If it is of moderate size, it will very likely be put in an iron flask. Then special molding sand is rammed about the pattern, the sides of the flask confining the sand within bounds. The pattern is removed from the sand, which may be easily accomplished even with a pattern as complicated as that for a locomotive cylinder, because

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it will be made as a "split" pattern of loose parts which may be removed separately from the sand mold without breaking it.

Now comes the particular part of the work. Every detail of the mold is carefully tooled by the molder and the face of the mold is coated with a black graphite to make the casting peel well, that is, draw from the mold without the sand sticking to it and leaving a rough surface. The mold is closed and the metal poured into it through an opening in its top called the gate. The pouring is called casting, which changes the name of the pig iron to cast iron. After the metal solidifies, the casting is dumped out of the sand mold and allowed to cool.

Let us now investigate the source of some of the troubles experienced by the oxyacetylene welder. If the molder rams the sand too hard, it closes up the pores of the sand mold so that gases from the molten metal cannot be properly released even through the main vent at the opposite end of the mold to the gate, called the riser, and the gases become entrapped in the casting thereby forming cavities which are called blowholes. A casting in service may break because of these blowholes, and the welder finds their surfaces so hard that he wonders what to do with the job. The blowholes should be melted well back into good metal and then filled with the proper cast iron welding rod.

A welder may have to weld a casting constructed of thick and thin parts (Fig. 2). He may take the proper precautions to preheat and unheat the casting, but when the job is done a crack is found through one of the thin sections of the iron, and the failure is usually charged to improper preheating. It may have been due to careless foundry practice when the casting was made. As a rule iron castings are dumped from their sand molds while still red hot, and then, of course, the thin parts of the casting cool much more quickly than the thick ones. This may not cause any perceptible difference in the strength of the casting, but if a casting has only just solidified in the sand mold and it is dumped while bright red hot, the uneven contraction in the thick and thin parts will surely set up strains which almost but not quite crack the thin parts. Then when the oxyacetylene welder has to weld that casting the heating required will be sufficient to release the locked-up strains and a crack appears, which was due to careless founding and not to poor welding.

Fig. 2—Cast-Iron Table of Boring Mill Saved by Welding

Again, a casting similar to the above may have been allowed to cool to a supposed safe dark red before being dumped, but it was winter time and the casting was molded near an outside door and uncovered there. Then the cold air caused such rapid cooling that unequal strains resulted. If these internal strains would always show themselves as cracks when the casting was machined, it would avoid many broken cylinders and other kinds of castings, and also make the work of the welder much more successful.

Another explanation of the unexpected cracked casting at the end of a good welding job is that sometimes the corners of the casting are left too sharp. This will cause a crack to appear through the corner which is almost always due to poor crystallization. This will be explained in detail in another chapter. A casting should never have sharp corners The patternmaker in the wood shop should see that the corners of the pattern for the casting are well rounded, called filleting. This will provide for proper shape of corner for the casting to ensure good crystallization and the iron will be just as strong there as in any other part of the casting. Such filleted corners rarely ever cause the welder any trouble (Fig. 3).

Fig. 3—Use of Preheating Furnace During Welding of Cast-Iron Piston

Sometimes a welder when at work on new castings, supposed to be of exactly the same composition, may find some of the castings much harder to weld than the others. This is probably due to a change in the proportion of the chemical elements of the iron, which change may be due to the fact that the iron for the hard casting was the last drawn from the cupola, which is always the poorest in quality owing to the more unfavorable melting conditions in the cupola at the end of the heat. This last run of iron usually loses its softening carbon and silicon before it is poured, and hard castings result. The welder may have trouble with such castings because the metal is harder to flow with the torch, and the usual welding rod is really not of proper composition to make a soft weld, its silicon being too low. In such a case the welder should not use the regular welding rod, but should try to get a strip of what is known as high silicon iron from the foundry to serve as the filling metal.

There are other conditions which a welder has to meet in the welding of some iron castings. Sometimes the mold of a casting is not properly gated. Then after the molten metal has been poured into the mold it is not properly vented at the top, and the gases cause the upper layer of metal to boil which leaves it in a porous brittle condition. Strains are thereby set up in the upper part of the metal which cause no particular trouble until the surface is heated red hot, say by a welder. Then the strains let loose unevenly and the casting will be warped or bowed. Of course, even the welder himself may think he is responsible for the warping of the casting, but the fault really originated in the foundry.

Again the welder may have trouble in welding cast iron

due to carelessness at the cupola in the foundry. The limestone flux used in the cupola primarily to collect the slag of the molten iron, also serves as an absorber of the sulphur in the iron and the coke fuel. A mistake in the use of this flux will sometimes cause the sulphur to segregate in the iron casting. Then when the welder meets these patches of high sulphur iron he will have the greatest difficulty to make a good weld, and he will wonder why part of the casting welded so easily while other parts seemed so different. It is almost impossible to make a good weld of sulphurized cast iron. About the best thing to do to such a job is to use a pure wrought iron welding rod instead of the regular welding rod. The pure iron rod being very low in sulphur tends to absorb some of the sulphur of the cast iron as the two metals are melted and run together, leaving a somewhat neutralized mixture of sufficient strength and fusion qualities to make a satisfactory weld.

We have thus given some illustrations of the source of weaknesses in some iron castings which may cause trouble for the oxyacetylene welder. They are intended merely to

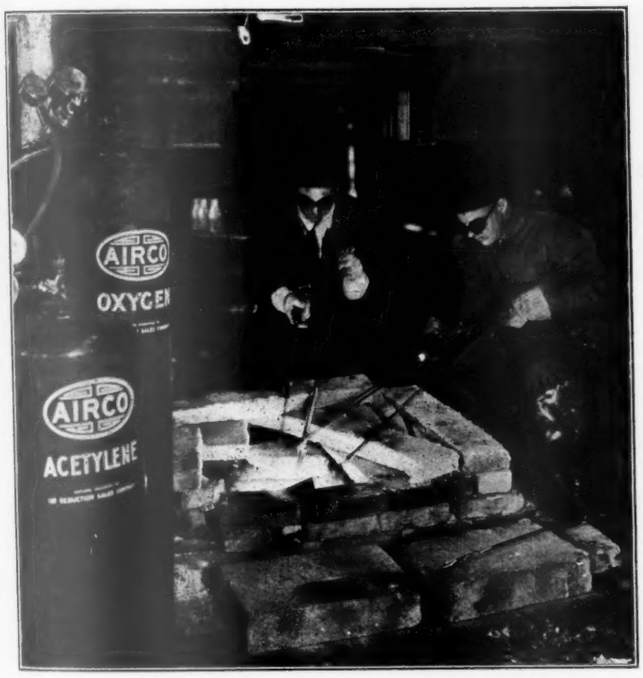


Fig. 4—Welding Cast-Iron Base of Power Hammer

help him to better understand the problems he may meet in the welding of this metal. He must not forget that most iron castings have been properly made and that therefore there seldom are any good reasons why a welder should not make a good cast iron weld. The poor castings are the exception, not the rule (Fig. 4).

Chemical Nature of Cast Iron

It will be well to remember that the principal difference between cast iron and all the other irons and steels is the amount and proportion of the same chemical elements of the metals. An oxyacetylene welder of experience with cast iron knows that the metal will act strangely at times under the welding torch, while on other occasions it will melt and flow without any difficulty. This often is due to the chemical composition of the iron.

There are five chemical elements in all irons and steels; namely, carbon, silicon, manganese, phosphorus, sulphur. A glance at the percentage composition of the typical irons and steels will show how much they are alike in chemical elements and still how very different they are in physical nature.

	Wrought iron	Machinery steel	Tool steel	Malleable iron	Cast iron
Carbon	.04	.15	1.00	2.25	3.25
Silicon	.05	.01	.15	.60	2.25
Manganese	.04	.50	.45	.20	.80
Phosphorus	.15	.07	.03	.15	.30
Sulphur	.02	.05	.03	.06	.08
Pure iron	99.70	99.22	98.34	96.74	93.32
Total	100.00	100.00	100.00	100.00	100.00
Tensile strength (lb. per sq. in.)	50,000	55,000	100,000	45,000	20,000

It will be seen that just by changing the amount and proportions of the chemical elements the pulling strength, called tensility, is greatly affected. For example, notice the loss of tensile strength between tool steel and cast iron of from 10,000 to 20,000 lb. per sq. in. due principally to increasing the amount of carbon and silicon. Just so these elements vary and affect the different grades of cast iron as the following table will show:

	No. 1 iron	No. 2 iron	No. 3 iron	No. 4 iron	No. 5 iron
Carbon (graphitic)	3.50	3.00	2.50	2.00	.20
Carbon (combined)	.15	.40	1.50	2.00	3.80
Silicon	2.40	2.50	.70	.60	.40
Maganese	.30	.70	.30	.70	1.00
Phosphorus	1.25	1.00	.25	.20	.04
Sulphur	.02	.02	.01	.08	.02
Tensile strength	15.000	20,000	40.000	25,000	18,000
Color of fracture	Dark gray	Medium gray	Light gray	Mottled.	White

The tensile strength of cast iron gradually increases from 15,000 lb. per sq. in. for No. 1 to 40,000 lb. for No. 3, and then decreases to 18,000 lb. for No. 5 iron. This is due to the relative proportions of graphitic to combined carbon.

By referring to the last table it will be seen first that there are five different grades of cast irons, and second that some are much stronger than others. Besides the hardness of these irons varies considerably, No. 1 being the softest, and the others increasingly harder up to No. 5 which is hardest of all, and too hard to be machined.

No. 1 iron is used for castings which must be very soft and do not require high tensile strength. Castings for electrical machinery are a good example.

No. 2 iron is stronger and harder than No. 1 iron, and would be found in castings for bed plates of machinery, brake shoes, general machinery, castings not subject to high strains, ornamental castings and the like.

No. 3 iron is still harder and has the highest tensile strength of all. It is used for locomotive and other high pressure cylinders, automobile and gas engine cylinders, high pressure pipe, flywheels, pulleys and other castings requiring the highest strength with good machinability.

No. 4 iron is getting a bit too hard for being machined. It is of good composition for car wheels, jaws for crushing machinery, hydraulic cylinders and for castings of hard wearing surface and of good strength.

No. 5 iron is very hard and is used for castings, which must resist wear, like balls and shoes for polishing mills.

Now it will be seen that all iron castings are not alike, as welders sometimes think, and to make successful cast iron welds requires that the chemical composition and physical strength of each casting should be given consideration.

IN A PAPER on Turbine Gearing, read before the Liverpool Engineering Society, S. B. Freeman explains that there have been attempts to harden the materials from which gears are cut. Grinding to correct deformations caused in hardening is the penalty. Since helical wheels cannot conveniently be ground, the straight spur tooth must be adopted. Large wheels cannot be ground at all by reason of technical difficulties. Methods of hardening the teeth locally by oxyacetylene or electric arc heating and rapid quenching are also being tried. The most common defects so far experienced in forged steel have been inadequate heat treatment and slag inclusions.—*The Engineer.*

Fuel Economy from Old Power Plant Equipment*

By A. R. Mumford
Assistant Fuel Engineer, United States Bureau of Mines

THE fuel economy of a power plant may be better than its anxious friends realize. A watchful superintendent of a government plant, knowing that improvements in plant equipment had been made since his stokers were installed, was almost persuaded to substitute a new type. The Bureau of Mines was asked to ascertain the actual performance of the old stokers and found the plant already doing from three to five per cent better than promised for the new equipment.

The value of accurate knowledge of plant performance, and the need of equipment to weigh and measure quantities is thus demonstrated. The boiler and stoker efficiency was found to be 75 per cent, and the overall efficiency of the boiler, stoker, and economizer was 78 per cent. Both records are high, and are to be attributed to care in operation, to good working condition of the plant, and to the low rate of evaporation, which was only about two-thirds of the boiler's rated capacity.

Description of Plant Test

The plant tested consisted of two Babcock & Wilcox boilers fired by means of overfeed stokers and equipped with a fuel economizer in the uptake. The boiler supplied steam to two large water pumps. One of these pumps was operating continuously, the other being used only intermittently.

The results of the tests, appended in the table below, were computed from readings collected over a period of 100 hours, from 8 a. m. Monday, May 30, to 12 noon Friday, June 3, 1921. The flue gas losses were determined by analyzing gas samples and observing gas temperature for 20 hours with one water pump running, and for 16 hours with two water pumps running.

The coal was weighed in large truck loads and it was brought from the storage space.

The water, fed to the boilers through the economizers, was metered by a Neptune water meter as it left the feed pump. The meter was tested before and after tests by weighing water passed through it. The meter was read every hour both day and night. The temperature of the water as metered was read every four hours during the test from a thermometer inserted in the feed pump suction line. The temperature of the water as it entered the economizer and as it entered the boiler, after passing through the economizer, was observed every 30 minutes each day and every four hours each night, by means of thermometers inserted at corresponding points in the boiler feed line. The pressure of steam in the boilers was read every hour both day and night.

The level of the water in the boilers was brought to the same point at the end of the test as it was at the beginning.

The temperature of the gases leaving one of the boilers was measured by an exposed copper-constantan thermocouple which was inserted into the center of the opening through which the gases left the boiler. The proximity of the two banks of boilers at the plant made it impossible to place a thermocouple in the corresponding position on the other boiler. This temperature was recorded every 30 minutes.

The temperature of the gases leaving the economizer was measured by two exposed copper-constantan thermocouples inserted at the vertical center and spaced equally across the width of the opening through which the gases left the economizer. These temperatures were recorded every 30 minutes during each day, and their average was taken as the temperature of the gases leaving the economizer.

*Report of investigation by the Bureau of Mines, Department of the Interior.

Samples of gas were drawn from each of the points at which temperature measurements were made; that is, one sample as the gases left the boiler and one as the gases left the economizer. The samples were drawn continuously over half-hour periods during each day and analyzed in a water Orsat.

The coal samples were obtained from a pile made by throwing one shovelful aside for every 20 that were thrown into the weighing car. This pile was reduced by crushing and quartering to the three five-pound samples sent to the chemical laboratories of the bureau at Pittsburgh for analysis.

All of the ash removed from the furnace during the test was weighed and dumped in a single pile. This whole pile was reduced by crushing and quartering to the three five-pound samples on which the analysis was made.

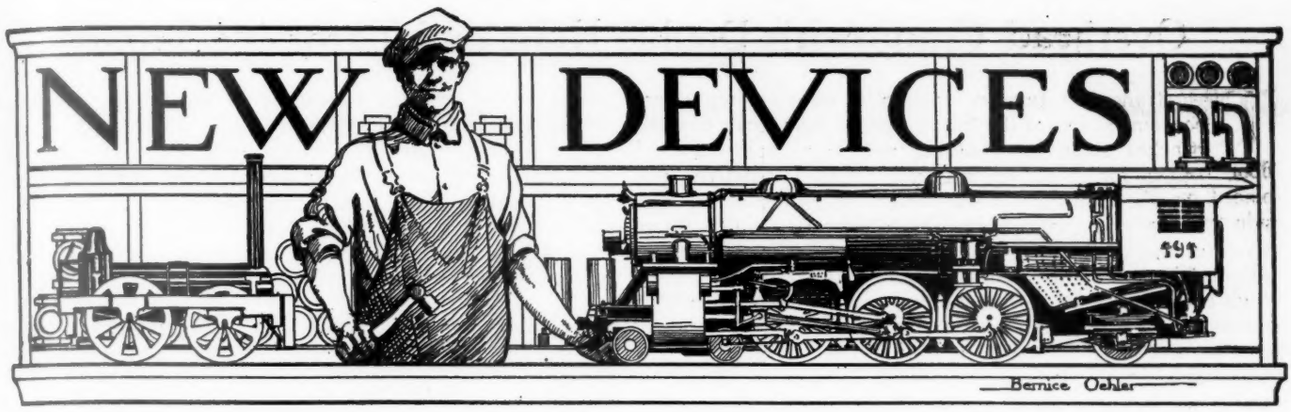
The average figures and the results of the test are given in the following table:

RESULTS OF TESTS OF TWO BOILERS AND ECONOMIZER

General Particulars—Equipment		
1.	Type of boilers	Babcock & Wilcox, water tube
2.	Type of economizer	Green fuel economizer
3.	Type of stoker	Overfeed
4.	Heating surface, each boiler	2,058 sq. ft.
5.	Heating surface, both boilers	4,116 sq. ft.
6.	Heating surface, economizer	1,843 sq. ft.
7.	Grate surface, each stoker	45 sq. ft.
8.	Grate surface, both stokers	90 sq. ft.
9.	Production of draft	Chimney
General Information		
10.	Duration of test	100 hrs.
11.	Duration one pump and auxiliaries running	49⅔ hrs.
12.	Duration two pumps and auxiliaries running	50⅓ hrs.
Coal		
13.	Total coal fired	88,000 lb.
	Ultimate analysis coal as fired:	
14.	Hydrogen	4.5 per cent
15.	Carbon	80.1 per cent
16	Oxygen and nitrogen (by difference)	6.3 per cent
17.	Sulphur	.6 per cent
	Proximate analysis coal as fired:	
18.	Moisture	2.3 per cent
19.	Volatile matter	17.0 per cent
20.	Fixed carbon	72.2 per cent
21.	Ash	8.5 per cent
22.	Calorific value	13,900 B.t.u. per pound
Ash and Refuse		
23.	Total removed	6,700 lb.
24.	Carbonaceous content	19 per cent
25.	Earthy matter content	81 per cent
Flue-Gases and Air		
	Composition, per cent by volume, dry.	
	Cases leaving boiler No. 1, average for test:	
34.	Carbon dioxide	10.9 per cent
35.	Oxygen	8.6 per cent
36.	Carbon monoxide	0.6 per cent
37.	Nitrogen	80.5 per cent
	Gases leaving economizer, average for test:	
36.	Carbon dioxide	9.6 per cent
47.	Oxygen	10.0 per cent
48.	Carbon monoxide	0.0 per cent
49.	Nitrogen	80.4 per cent
	Excess air:	
52.	In gases leaving boiler No. 1, average for test	66 per cent
55.	In gases leaving economizer, average for test	86 per cent
	Temperatures:	
58.	Gases leaving boiler No. 1, average for test	455 deg. F.
61.	Gases leaving economizer, average for test	327 deg. F.
62.	Air in fire-room	84 deg. F.
Feed Water and Steam		
63.	Total water fed to boiler	906,800 lb.
64.	Total water fed to boiler per lb. coal as fired	10.3 lb.
65.	Steam pressure	154 lb. per sq. in.
66.	Temperature of water entering economizer	171 deg. F.
67.	Temperature of water entering boiler	211 deg. F.
68.	Heat transferred to 1 lb. of water in economizer	40 B.t.u.
69.	Heat transferred to 1 lb. of water in boiler	1,016 B.t.u.
70.	Heat transferred to 1 lb. of water in boiler and economizer	1,056 B.t.u.
Rates		
71.	Coal fired per sq. ft. grate per hr	9.8 lb.
72.	Water evaporated per hr	9,068 lb.
73.	Heat transmitted per sq. ft. boiler heating surface per hr	2.2 B.t.u.
74.	Heat transmitted per sq. ft. economizer heating surface per hr.	.0.2 B.t.u.

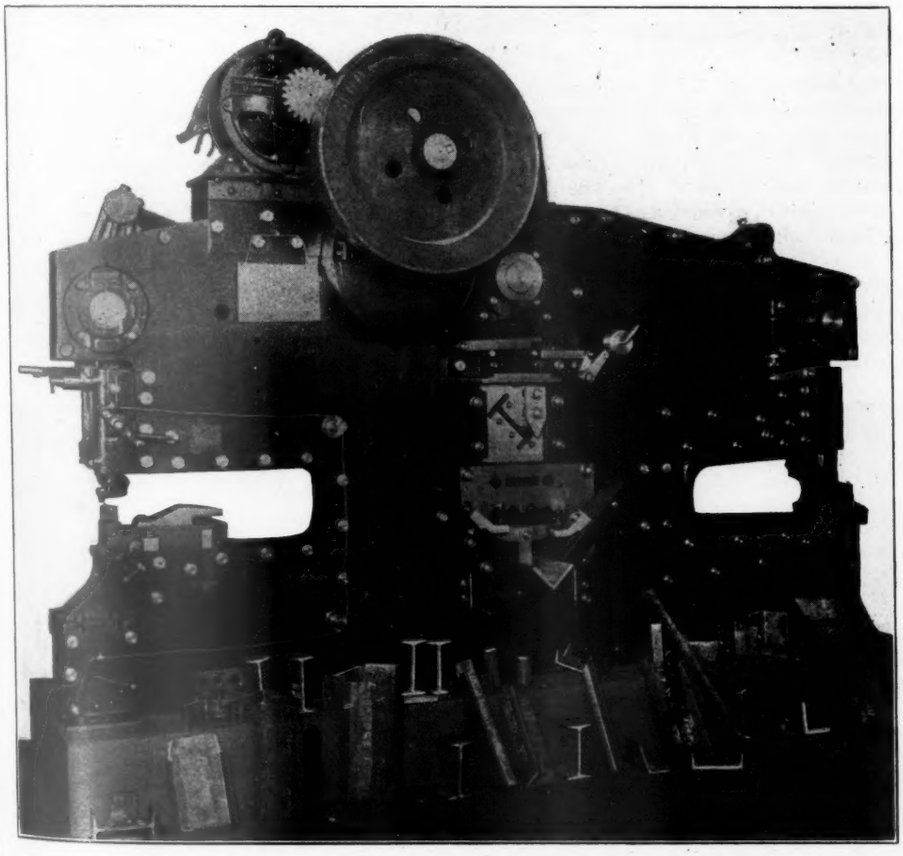
Heat Balance, Boilers and Economizer, Per Lb. Coal as Fired

		B.t.u.	Per cent
75.	Heat absorbed by boiler (and thermal efficiency boiler only)	10,460	75
76.	Heat absorbed by economizer	410	3
77.	Heat absorbed by boiler and economizer and overall—thermal efficiency	10,870	78
78.	Heat lost in dry gases leaving economizer above fire-room temperature	1,260	9
79.	Heat lost in steam in flue gases leaving economizer above fire-room temperature	470	3
80.	Heat lost by not burning carbon monoxide	0	0
81.	Heat lost in carbonaceous matter in ash and refuse	160	1
82.	Radiation loss and errors	1,140	9
83.	Total (Items 77-82) and calorific value of coal	13,900	100



Triple Combination Punch and Shear

THE combination punch, plate shear and bar, angle and tee cutter, illustrated and known as the type Bluefg, is being introduced to the railroad field by Henry Pels & Co., Inc., New York. This machine has given satisfactory service in various industries throughout the world and is accompanied by the strongest guarantees as to capacity, quality of material and workmanship. Owing to its heavy forged steel plate construction, the main frame is said to be absolutely unbreakable. This machine is particularly valuable for railroad as well as industrial shops because it will punch and cut boiler plate, shear rounds, squares, flats, angles and tees and bevel angles and tees from the smallest size up to the capacity of the machine, wholly without tool changes.



Pels Triple Combination Punch, Plate Shear and Bar, Angle and Tee Cutter, As Mounted on Special Foundation at Atlantic City Convention; Examples of Work in the Foreground

In addition, the Pels combination punch and shear will cut with interchangeable blades, beams and channels up to its capacity. Another important advantage is that three men can operate the machine simultaneously at its highest capacities without interfering with each other. Coping, notching and special punching attachments can be furnished as desired; also, blades for cutting rails or special shapes. The machine is made in nine sizes of any throat depth required.

When dull knives are used for cutting thin sheet steel, a greater stress is put on the machine than if a much thicker plate is cut with sharp knives. Sometimes a hard spot in the metal will cause the tensile strength to jump from 62,000 lb. per sq. in. to 100,000 lb. per sq. in. or over. This almost doubles the power required to shear the metal, and the forged steel plate frames of the Pels machines are designed to resist just such pressures. These plates are made up to 6½ in. thick.

In addition to a high quality frame, all gears of this machine are of steel with cut teeth. The pinions are machined from forgings. All bearings are bushed with phosphor bronze, being of ample size to carry the load without undue unit pressure. Ball or roller bearings are used where necessary. All working parts are forgings, the shafts being of crucible steel of generous dimensions. The main shafts have ring oilers and many of the eccentrics run in oil. Taper gibs are provided with easy adjustment to take up wear. No cast-iron parts are used in this machine.

It is obvious that the combination of so many functions in a single machine without tool changes is a great time-saving feature. A large proportion of locomotive and car repair work, for example, cannot be finished in a single operation. A plate usually has to be sheared and punched and then an angle, tee, or beam cut to go with it. These operations can all be performed on the Pels machine without losing time and effort in going to three different machines.

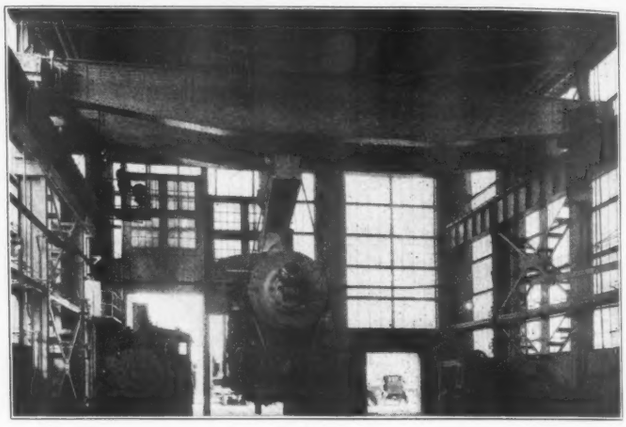
Overhead Crane with Double Hoist and Turntable Trolley

THE transverse type of locomotive repair shop offers economical use of the floor space, is convenient to work benches along the building walls and facilitates the floor traffic for handling material. The locomotives are placed on the transverse tracks either by means of an outside transfer table, which requires almost as much ground space as the shop itself, or by overhead traveling cranes of the double trolley type, which in turn necessitate a building high enough so that one locomotive can be carried above the others. In the longitudinal shop the locomotives are handled by two single trolley cranes and to economize on space the buildings should preferably be high enough to clear the tracks for carrying the engines to their different locations.

A type of overhead crane which makes it possible to combine the advantages of both types of shops has recently been developed by the Shaw Crane Works of Manning, Maxwell & Moore, Inc., New York. The photographs show a crane of this type installed at the River Rouge repair shop of the Detroit, Toledo & Ironton. The shop is narrow, the crane having only a 56-ft. span, and the engines are brought in on a longitudinal through track, running along one side of the building. For practical reasons the engines, or boilers as the case may be, must be placed crosswise while undergoing repairs, and it is necessary to turn them through 90 deg. This has been done heretofore by the use of two overhead cranes, a scheme which is both cumbersome and hazardous.

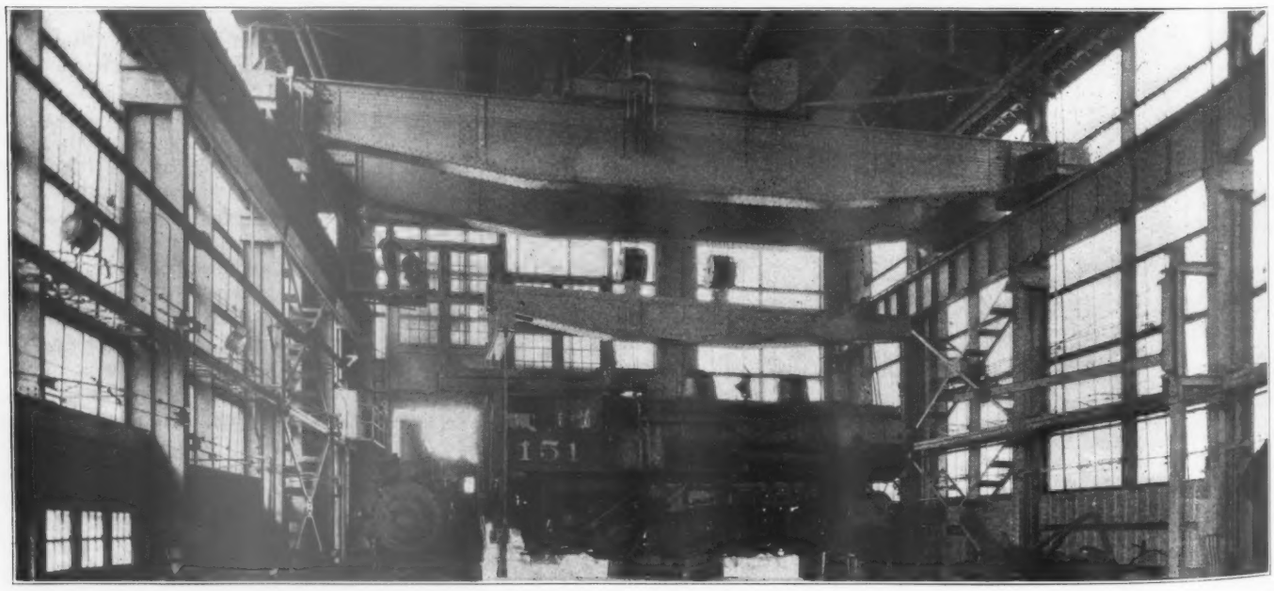
In the Shaw crane the problem has been solved by incorporating a turntable in the crane trolley so that the crane has four different movements, i.e., hoisting, cross travel, longitudinal travel and horizontal rotation. Thus it is practical to lift the engine off the longitudinal track, carry it down the shop and swing it into transverse position wherever there is a vacant repair pit. At no time is it necessary to lift one engine above another.

A crane of this type saves the wasteful use of ground space for a transfer table on the one hand or on the other hand the heavy and costly building necessitated if provision is made for handling one engine above another. The turntable crane trolley consists essentially of two parts, one upper revolving frame and one lower or trolley frame proper. The upper frame carries the hoisting machinery only. Two sets of ropes, spread seven feet apart and both operated on the same drum, carry a lifting beam which is provided with adjustable slings to accommodate different sizes and shapes of engines or boilers. This lifting beam is easily detachable and by substituting a short beam with a simple hook in the center, the crane may be converted into a standard traveling crane. On the under side of the revolving frame is attached a combination ring gear track and roller path, which in turn rests on conical rollers set in the lower or trolley frame. The lower frame also is provided with horizontal guide wheels to keep the roller path central. The revolving frame is turned by a motor mounted on the lower frame, which drives a large pinion meshing in the ring gear of the roller path, through a bevel and spur gear train. The lower trolley frame is equipped with the customary motor driven cross travel machinery. The crane bridge is practically standard.



Lifting the Locomotive from the Longitudinal Track

Each set of falls has a lifting capacity of 50 tons and the turntable has a rotative speed of 1½ r.p.m. The crane shown is not equipped with an auxiliary hoist, but this can be included.



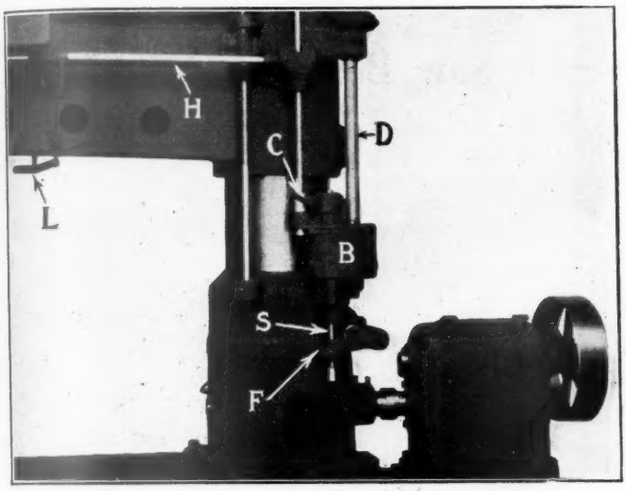
Shaw Crane with Trolley Turntable Rotated 90 Deg.

crane occupies practically no more room than a standard three movement crane and the cost is but little greater.

By reference to illustration it will be noted that the

Power Column Clamp Applied to Radial Drill

IN drilling at the extreme end of the arm on a large radial drill, it is inconvenient for the operator to leave his place and tighten the swinging column at each shift of the drill. Extra steps must be taken and the operator's attention is distracted from the drilling operation under way, with a resultant slowing down of production. To overcome this difficulty and make its radial drills more flexible and readily controlled, the Dresses Machine Tool Company, Cincinnati, Ohio, has brought out a power column clamping device. This device does not interfere in any way with the downward movement of the arm on the column and it is operated mechanically without the necessity of pneumatic hose or pipe connections.



Dresses Radial Drill Equipped with Power Column Clamp

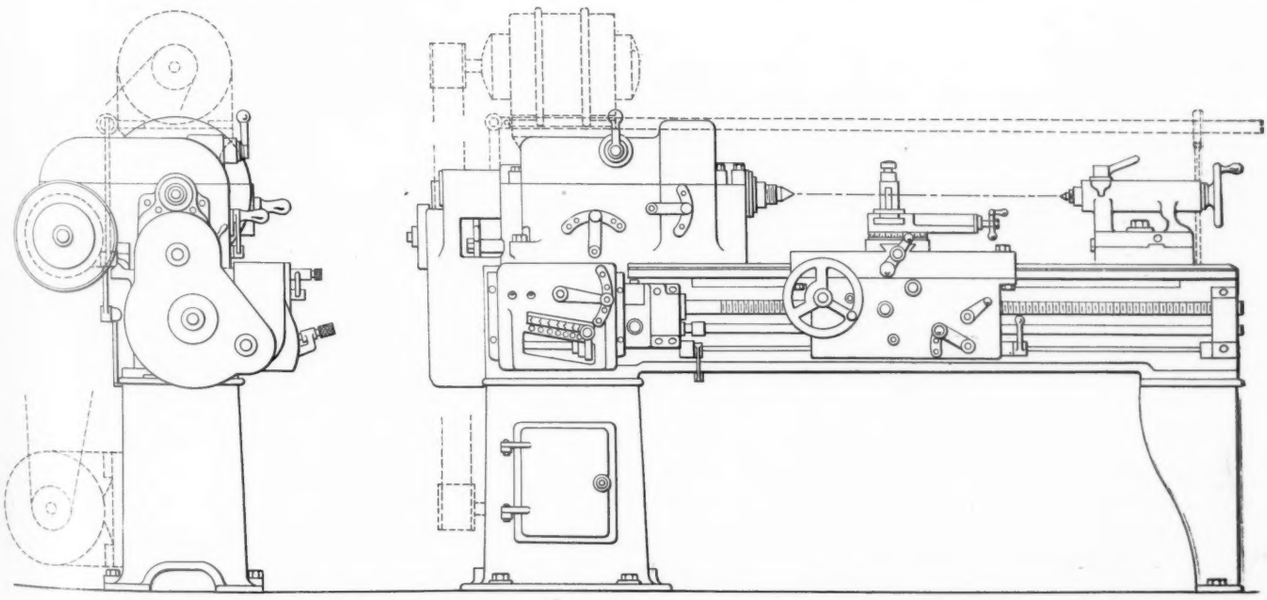
The illustration shows the rear of a Dresses radial drill with the new power column clamp applied. The device is attached to the lower bearing bracket of the vertical driving shaft *D* which furnishes the power. The shaft extends through the oval box *B* and, by means of friction clutches driven indirectly, the screw *S* below the box runs right or left-handed. On this screw works a nut to which is attached fork lever *F*. The hub of this lever is tapped and works on the column binding screw.

The engagement of the friction clutches in connection with the screw is accomplished by cam *C* on top of the box. This cam is operated by a splined vertical shaft, illustrated, a pair of bevel gears and horizontal shaft *H* which extends to a bearing on the extreme end of the radial arm. Shaft *H* is operated by lever *L* and connecting links which are attached and move with the drilling head. The friction clutches are self releasing and also slip at either end of the tightener levers, this movement preventing breakage.

Adaptable Quick Change Geared Head Lathes

TWO views of the latest type of quick change geared head lathe, made by the Cincinnati Lathe & Tool Company, Cincinnati, Ohio, are shown in the illustration. Machines of this type are furnished in sizes from 16-in. to 30-in. swing. Perhaps the most distinctive feature is wide adaptability in general machine shop work. The 16-in. lathe illustrated will machine work at the full swing of the lathe at a cutting speed of 55½ ft. per min. and work as small as ½-inch in diameter can be operated at 54 ft. per min. The 12 spindle speeds are quickly and easily obtained by adjusting the three handles shown in front of the head. The range is from 13.5 to 400 r.p.m., all speeds being in geometrical progression. It is said that the full range of these speed changes can be made in a length of time not exceeding 12 seconds.

Whenever desired, an apron control is supplied with this lathe. Direct connected motor driven lathes can be provided with either chain or belt drive with idler pulley when desired. In case motor drive is preferred, the driving motor can be mounted either on the head stock or on the rear of



Drawing Illustrating New Line of Cincinnati Lathes Designed for General Machine Shop Work

the cabinet leg. When the lathes are supplied for single pulley belt drive direct from the line shaft, a rod is provided as shown at the top of the lathe or a handle for stopping and starting.

The powerful but sensitive disc clutch with brakes supplied in the new Cincinnati lathes has a neutral position which disconnects the spindle from all gearing, thus obviating the fly wheel effect of having heavy gears attached to the spindle. This feature is an important time saver while centering irregular work in the chuck, or in machining small parts where the chucking time is a large factor.

Surplus power to drive the lathes is insured at all times. For example with the 24-in. lathe, a 7½-h.p. motor is recommended, but with sufficient belt tension the lathe will absorb 15 h.p. under heavy cuts. Other sizes are in the same proportion, high power being developed and making the lathes adaptable to the more or less heavy duty encountered in railroad machine shop work.

Ball Bearing Universal Saw Bench

DESIGNED for ripping, cross cutting, dadoing and other accurate woodworking operations, the universal saw bench, illustrated, has been brought out recently by the American Saw Mill Machinery Company, Hackettstown, N. J. The bed of this machine is cast in one piece with a partition just behind the saws. This forms a bin for the saw dust with an opening for the exhaust pipe. A large door provides easy access to the saws. The table tilts to 45 deg. and has a scale showing the exact angle. The stationary section of the table is graduated for ripping up to 22 in. wide. The traveling section of the table runs on ball bearing rollers or can be locked in place. A lever moves it out 2¼ in. to provide space for the dado head.

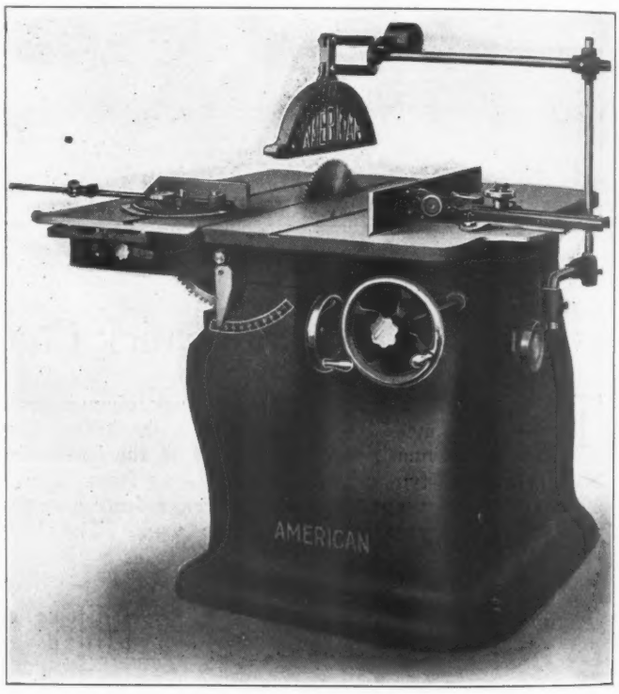
The ripping gage will admit work up to 22 in. wide and has a 9-in. travel on a rack and pinion, allowing it to be quickly and accurately adjusted. The fence tilts to 45 deg. and angles to 35 deg.

A mitre cut-off gage can be used on either side of saw as the stationary and traveling tables are both provided with slots. It can be locked to the traveling table and move with it if desired. Graduations are provided to 60 deg. in both directions. The gage is equipped with a yoke for working on both sides of the saw. An adjustable stop gage is attached to the cut-off gage and is provided with a finger which clears the work when trimming.

The frame carrying the saws is heavy and mounted on a large shaft which revolves in bearings in the bed. A strong support is given to the saw frame by placing one of these bearings outside of the saws. Saw mandrels are accurately ground and mounted in ball bearings. Saws up to 14 in. in diameter may be used, a 14 in. saw projecting above the table 3½ in. A universal adjustable saw guard is furnished.

Hand wheels for tilting the table and for revolving the saw frame are located in the most convenient positions. The countershaft may be placed on the floor or underneath the floor. The loose pulley for the countershaft is fitted with roller bearings. The belt compensating device is provided with idler pulleys running in ball bearings. The equipment furnished includes one 14-in. cut-off saw, one 14-in. rip saw, a countershaft and belt shifter, ripping gage, mitre cut-off and stop gage, wrench, extension for mandrel to carry 2-in. dado with 1½-in. hole and a saw guard. This machine can also be furnished with babbitted bearings instead of ball bearings.

The floor space required is 48 in. by 44 in. and the size



American Ball Bearing Universal Saw Bench

of the table 44 in. by 38 in. The tight and loose pulleys are 10 in. by 4½ in.; recommended speed, 750 r.p.m. The mandrel pulleys are 4 in. by 5 in.; recommended speed, 3,000 r.p.m. The power consumption of the machine is from 3 to 5 hp.

High Speed Inserted Point Lathe Center

THE inserted point lathe center, illustrated, is made by the Detroit Twist Drill Company, Detroit, Mich., and consists of two parts, a high speed steel center or point, and a sleeve of hardened carbon steel. The sleeve which serves as the holder is not subject to wear, and is permanent. The center fits into the tapered hole of the sleeve which takes up all wear, thus insuring accurate alinement and rigidity at all times. Both the hole and the center are ground to a Morse taper.

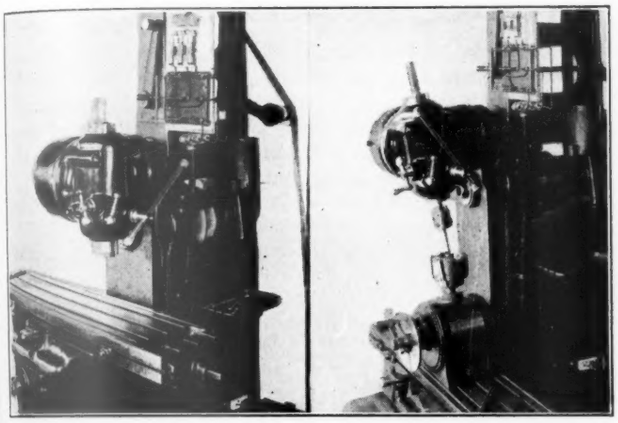
Detroit Lathe Center with Inserted High Speed Steel Point

Only 10 sec. are required to change a point which can be done without removing the sleeve from the machine. This feature saves much valuable man and machine time. The high speed steel point has a long life, outlasting from 10 to 100 carbon centers and, when a new point is required, its cost is less than that of salvaging the ordinary center.

Inserted point centers eliminate delays and shut downs due to burned and frozen points; reduce point grinding on the part of high-priced mechanics; permit the operation of lathes and grinders at continuous maximum speed, and cut the time for changing centers to an absolute minimum. The Detroit inserted point center has proved its value by extended tests.

Universal Milling and Drilling Attachment

A COMBINATION universal milling and drilling attachment valuable in tool rooms having considerable angular milling work to do has been developed recently by the Rockford Milling Machine Company, Rockford, Ill. This attachment is of substantial proportions as indicated in the illustration, being designed to stand up under heavy cuts.



Two Views of Rockford Universal Milling and Drilling Attachment

Four clamping bolts are provided to hold the attachment rigidly to the face of the milling machine column. There are two graduated bases at right angles to each other, both of which can be swiveled through 360 deg., this construction making the spindle completely universal.

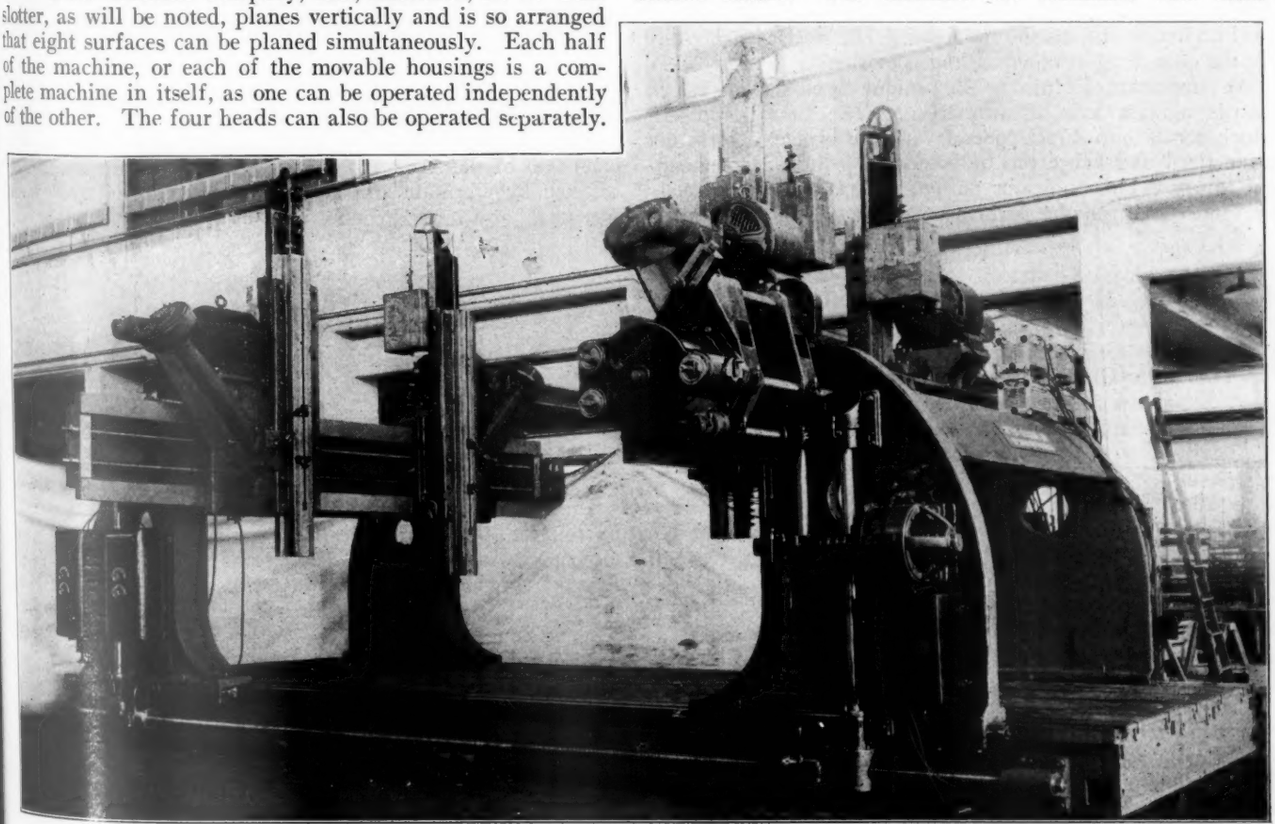
The drive is by means of a geared connection from the back of the main spindle through a driving sleeve substituted in place of the overhanging arm. From this sleeve the drive is transmitted through bevel gears, driving a set of hardened steel bevel gears solidly mounted on a shaft and arranged to drive the attachment spindle. An additional advantage is afforded from the fact that the main spindle of the machine is left free to be used as desired. On many jobs it is possible to do milling with the cutter inserted in the main spindle of the machine and angular milling or drilling at the same time.

It will be readily apparent that the many combinations of milling and drilling operations possible with this attachment make it unusually adapted for die cutting and similar work.

Traveling-Head Slotter of New Design

A NEW type of traveling head slotter has been built recently for the Commonwealth Steel Company, by the Betts Machine Company, Inc., Rochester, N. Y. This slotter, as will be noted, planes vertically and is so arranged that eight surfaces can be planed simultaneously. Each half of the machine, or each of the movable housings is a complete machine in itself, as one can be operated independently of the other. The four heads can also be operated separately.

The machine is used for slotting and vertical planing locomotive and passenger truck frames and other work of a similar nature. The machines are furnished with extra



Betts Traveling-Head Slotter Equipped with Four Separately-Operated Tool Heads

heavy beds of any required length, on which are mounted the heads, and along which the heads can be traversed or fed. The heads are equipped with cross rails on which the tool bar saddles are traversed and fed across the machine. Each saddle has a rectangular tool bar, driven by a spiral worm which engages a wide rack of coarse pitch on the back of the tool bar. The tool bars or rams are balanced by counterweights and the stroke of the bars on each head is electrically controlled, one waiting for the other at the end of each stroke.

Each saddle and tool bar is equipped with a separate reversing motor, driving through worm and worm wheel at an angle of approximately 45 deg. This type of drive has long been in successful use on certain types of Betts machines where the service required was unusually severe. Each head is equipped with a separate electric feed motor which transmits power to two non-revolving screws for feed and rapid traverse to the heads as well as to the saddles on the cross rail.

A Simple Instrument for Steel Treaters

IN heat treating steel, quenching should always take place at the lowest temperature at which the particular steel will harden and an instrument known as the Kritiskope, designed to indicate these temperatures has been placed on the market by Herman H. Sticht & Company, New York. When most tool steels are ready to normalize, anneal or harden, the steel becomes non-magnetic at the critical points and the Nilson Kritiskope is designed to utilize this characteristic.

The device consists essentially of a high grade permanent magnet located within the Kritiskope proper and used to magnetize an indicator, pivoted in a slot in the end in such a manner that ordinarily it remains in alinement with the permanent magnet. This indicator is attracted by any magnetized piece of steel being heated in the furnace and remains in contact with that steel when the Kritiskope is in close proximity.

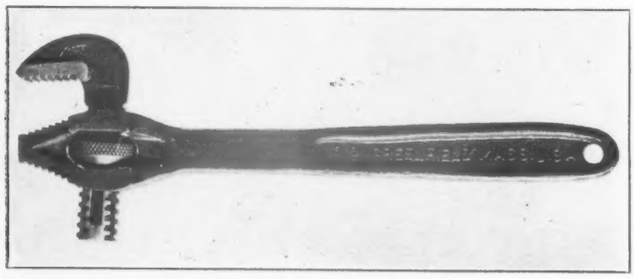
In operation as the steel approaches the cherry red condition, the furnace door may be opened slightly and the Kritiskope inserted so that the magneto-sensitive end first touches the material and then is withdrawn a trifle. If the steel is still magnetic the indicator is seen to remain in contact with the steel. This operation may be repeated from time to time as the rise in temperature proceeds until the steel no longer attracts the indicator. The steel is then ready for the quenching or other cooling operation.

An important feature is the unique arrangement which guards against loss of magnetism. The indicator itself, which comes into direct contact with the heated steel is not magnetized and hence can be heated to a high degree without injury. This indicator receives its magnetization solely by induction from the permanent magnet. This magnet is protected against any undue rise in temperature by the special design of the Kritiskope and its thick walls. Since the instrument is exposed to heat for only short periods of time there is no danger of the permanent magnet being injured. The Kritiskope is furnished complete with extension rods and a hand protection shield. Advantages claimed for this instrument are that it is direct reading and indicates the condition of the steel; it does not require calibration, is not affected by vibration and is self contained, being free from any leads or electrical connections.

Nilson Kritiskope for Indicating Critical Points in Steel

Pipe Wrench Designed for Difficult Corners

THE Little Giant pipe wrench, embodying several interesting new features, has just been put on the market by the Greenfield Tap & Die Corporation, Greenfield, Mass. This wrench has the "end opening" feature which is familiar to users of machinists' wrenches. Its application to pipe turning can readily be seen by a glance at the illustration.



Little Giant Pipe Wrench Embodying New Principle of Design

One important advantage of the Little Giant wrench is the ease with which it can handle pipes in corners, close to walls, and similar confined places. The person using it can set it straight on the pipe as he would a pair of pliers, instead of having to fit the jaws on from the side. There are only three parts: a handle and jaw in one piece, which is drop forged and heat treated; a movable jaw, likewise drop forged and heat treated; and a hardened steel nut. In spite of the absence of springs the wrench is said to take hold and release instantly at the option of the user.

The new wrench has been designed for maximum strength, the 14 in. size having successfully withstood stresses in excess of 4,700 in. lb. without slipping or bending. Yet owing to the elimination of extra parts the wrench is relatively light in weight.

Another feature is the double set of teeth on the main jaw. The movable jaw can be engaged at the option of the

operator with either of these sets of teeth with consequently lengthened life. On the large sizes, 14 in. and greater, two additional sets of teeth are provided, making four in all, and the movable jaw can be reversed to engage these additional sets of teeth, which are below the adjusting nut. This is very useful in connection with certain classes of work, beside tending to quadruple the life of the tool.

The Little Giant wrench is being manufactured in 8-, 10-, 14-, 18- and 24-in. sizes, of which the three smaller sizes are already on the market.

Universal Slitting Shear and Bar Cutter

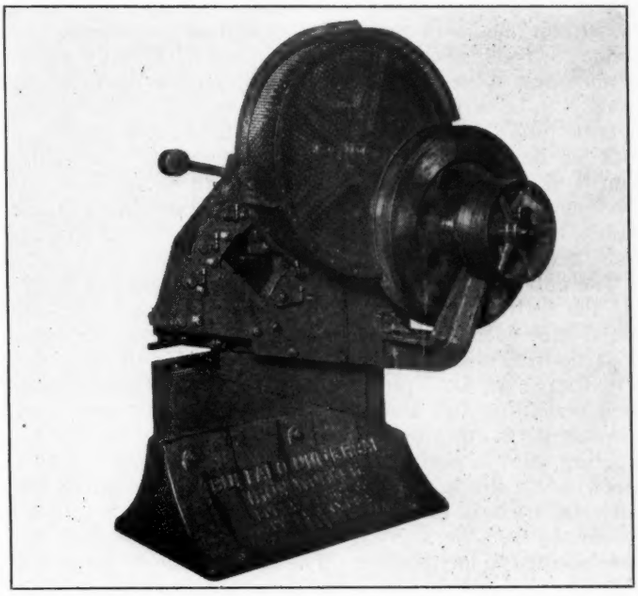
THE Buffalo Forge Company, Buffalo, N. Y., has just placed on the market a universal slitting shear and bar cutter. The shear is equipped with 10-in. knives which will cut plates ½ in. thick, of any length and width, or 6 in. by ⅝ in. flats. The knives may be operated at the rate of 30 strokes per minute.

The bar cutter has standard five-piece knives which will cut the following: 4 in. by 4 in. by ⅜ in. angles, square; 3 in. by 3 in. by ¼ in. angles 45 deg. mitre, left or right hand; 3 in. by 3 in. by ⅜ in. tees, square; round bars up to 1⅝ in. in diameter; square bars up to 1½ in.

With special knives, furnished by the Buffalo Forge Company, the bar cutter will take 5-in., 9.75-lb. beams and 5-in., 9.00-lb. channels, or any other rolled section having the same weight and area. One set of blades shears both channels and beams of the same size, a pair of knives being required for each size.

This machine has the Buffalo armor plate frame which is guaranteed unbreakable. Bearings are bronze lined. The drive shaft runs in oil-ring bearings. The gear and pinion are cut from semi-steel blanks. A feature of the machine is its cast iron base, which makes an expensive concrete foundation unnecessary.

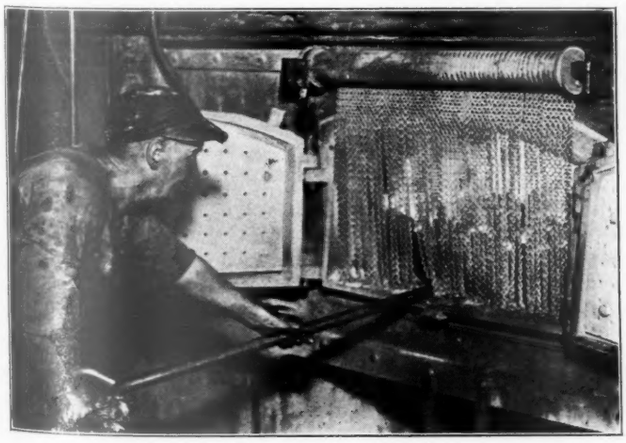
The length of the entire machine is 5 ft. 4 in., the width 2 ft. 8 in. and the height 6 ft. 4 in. The total weight is 4,500 lb. Approximately 3 hp. is required to operate the machine at capacity. In railroad blacksmith and boiler shops especially, the new Buffalo universal slitting shear and bar cutter should prove a valuable machine for saving time and expediting the work of these two important departments.



Buffalo Universal Slitting Shear and Bar Cutter for Railroad Shops

Chain Screen Doors for Boilers and Furnaces

RECENT developments in Wiegand chain screen doors, made by the E. J. Codd Company, Baltimore, Md., indicate that this device is of especial value in increasing the efficiency of furnace operation. The principal advantages of the chain furnace door are due to the fact that it is easily penetrable, affording an unhampered view of the interior of the furnace, and assisting materially in keeping heat in and cold air out. The door consists of a curtain of chain which effectively hinders the passage of gases, sparks and air. The loosely hanging strands of light chain are parted with ease and pressed aside by the tools or other objects projecting into the furnace only to fall together again and close the opening when the entrance has been effected. The operator is at the same time protected from the heat and can see what is going on in the furnace. It is said that fine coal and light shavings can be thrown through the chains from a shovel. When the screen is hit by the edge of the oncoming shovel, the chains swing inwards and upwards admitting the fuel.



Cleaning a Fire Through a Weigand Chain Screen Door

These chain screen doors are made in different types and with different methods of suspension for use on drop forge furnaces, annealing furnaces, electric furnaces and the furnaces of stationary boilers, etc. Wherever a furnace is kept at a high temperature and it is necessary to have a door for the feeding or manipulation of the contents, these auxiliary chain doors effect fuel economy, avoid damage and delay from chilling drafts to the furnace and contents and tend to provide the maximum possible efficiency, comfort and safety of the workmen.

The door shown in the illustration is automatic in action, the chains rolling down over the main boiler door opening as soon as the doors are opened. On other types of furnace in which the door slides vertically, the protecting screen door is so arranged as to drop automatically and cover the opening

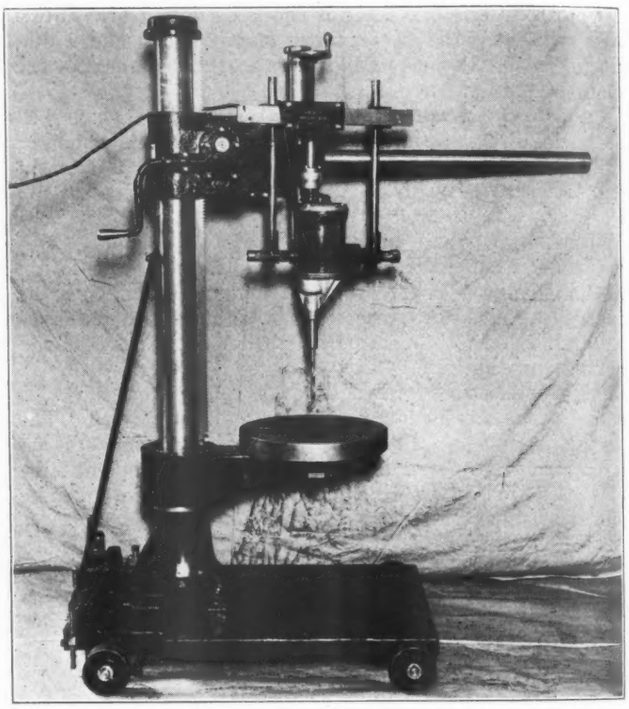
as the door is lifted. Tubular ends are sometimes provided on the chains to prevent tongs and other tools from catching. In some screens these tubes form nearly all the screens, only enough chain being left at the top to give flexibility and visibility. The tubes in this case hang very close together and make a practically air-tight door.

Portable Electric or Pneumatic Radial Drill

AN interesting design of portable radial drilling machine, known as the Lindhe portable radial has been placed on the market recently by Manning, Maxwell & Moore, Inc., New York. This machine equipped with an electric portable drill of suitable capacity is shown in the illustration. The tool is substantial in construction, consisting of a portable drill in a universal head, mounted on a radial arm capable of vertical adjustment on the column. The column swivels on a base rigidly attached to the truck which permits easy movement on the floor to various places where work is to be performed. The base is supplied with sliding bars, adjustable where the floor is not level; also offering a lock for the truck while the drill is in operation. The radial arm is movable on its brackets and can be swung in a full circle providing positions desired at any height or angle within its reach. An eyebolt in the top of the column affords means for lifting the machine with a crane.

The universal head, mounted on the radial arm and carrying the drill, will slide about and rotate around with the radial arm which furnishes additional movements for positions desired while drilling. The universal drill head has a feed screw for hand pressure while the drill is in operation, thus permitting full control. All of the above mentioned movable parts are provided with strong locking devices for securing them in position. All gearing is enclosed and dust proof, being self lubricating. The cross bar section on the universal head is provided with chains to furnish support should the work be heavy or if work is in an extremely remote position to the machine. The machine can be furnished with any make of electrical or pneumatic portable drill or with fittings so that the customer may attach his own drill.

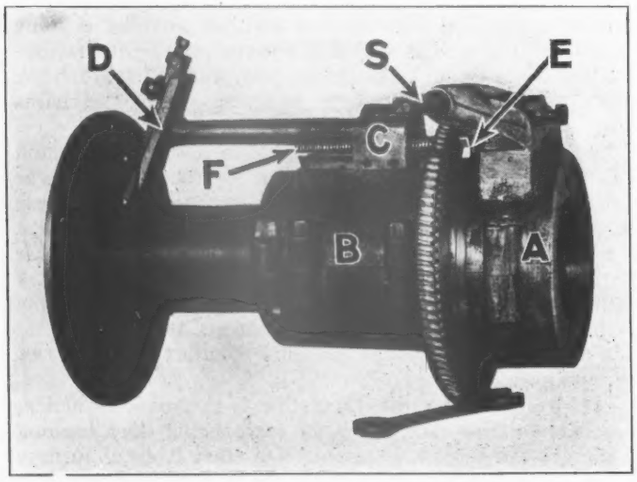
The base of the machine is 30 in. by 43 in., the extreme height of the drill above the floor being 5 ft. The radial arm is 4 ft. 6 in. long measured from the center of the column. The drill table is 18 in. in diameter which is also the distance from the center of the column to the center of the table. The diameters of the column, radial arm and wheels are 4½ in., 3 in., and 5 in. respectively.



Lindhe Portable Radial Equipped with Removable Electric Drill

Portable Locomotive Journal-Turning Machine

AN ingenious portable device for turning locomotive driving axle journals which has received the approval of practical railroad shop men is shown in the illustration. The principal object of the device is to provide a portable machine for truing locomotive and car journals, crank-pins, etc. This tool can be applied without removing the wheels, an important advantage at points not equipped with sufficiently large lathes or powerful hydraulic presses. Other advantages are that the device may be applied to axles of different sizes and by means of an improved clamping arrangement, the machine is held concentric with the original journal.



Journal-Turning Machine Set Up on Axle Ready for Operation

Referring to the illustration, the machine consists of a hollow stationary arbor *A* and a revolving tool arbor *B*, made in two parts for application to the axle with the wheels applied, and firmly held in correct alinement with each other by means of tongues and grooves and the necessary bolts. Tool arbor *B*, carrying the sliding tool post *C* and tool holder *D*, is rotated by means of a suitable electric or pneumatic motor attached to spindle *S* and transmitting power through a worm and the large worm wheel shown.

The feed for the cutting tool is obtained by means of star wheel *E*, direct connected to feed screw *F*. Every time the tool arbor revolves one point of the star engages a trip pin, giving the feed screw a partial revolution and advancing the cutting tool in proportion. Various types of tools may be employed in the tool arm *D*. A sliding tool post is provided

with a clamp screw by means of which the tool is held in place.

Particular attention is called to the ingenious method by means of which this portable journal-turning tool is alined in the proper position and rigidly held in place. Taper keys on the inside of stationary arbor *A* are driven simultaneously by means of a wedge collar shown at the right end in the illustration. This wedge collar is threaded externally and runs in an internally threaded chamber in arbor *A*. The wedge collar is turned by means of a spanner wrench, revolution of the wedge collar setting up the taper wedges uniformly. Extension keys are also provided so that the machine may be fitted to axles of different sizes. Inasmuch as the tightening action of the wedges increases steadily throughout the entire length, there is no greater stress at one point than another. Pressure is applied uniformly and the machine is positioned concentric with the original journal. Both United States and Canadian patents on this portable journal-turning machine have been granted to Claude E. Marsh, Atlanta, Ga.

Pneumatic Toggle and Lever Press

A GENERAL utility press, operated by compressed air or steam, has been developed for the market by the Hanna Engineering Works, Chicago. The type used for compressing or packing is shown in the illustration. This press is arranged as required with various forms of platens, tables or work-supporting structures which make it especially adaptable to straightening, bending, forcing, forging and similar work.

General Purpose Press Made in Capacities from 15 to 200 Tons

The length of die stroke is variable. No more than the rated pressure is exerted by the die regardless of the amount of die travel. The connecting mechanism between the die and the actuating air piston, being a combination of toggle and lever, results in the air piston, while traveling at a uniform speed, imparting to the die a gradually decreasing speed. Increasing pressure relative to the movement and pressure of the piston is secured during the first portion of its stroke. A substantially uniform speed and pressure and uniform relation to the movement of the piston is obtained during the last portion of the stroke. The first portion of the die stroke (increasing pressure stroke) is from 1½ in. to 4⅝ in. long, depending on the pressure rating of the machine. The last portion of the die stroke (uniform pressure stroke) is from ⅜ in. to 1⅛ in. long.

This press is made in 10 sizes from 15 to 200 tons. It is portable in the sense that it can be moved without moving any auxiliary equipment. The floor space required is small. Manipulation of the operating valve is by hand or foot. The die is mounted on an adjusting screw. For bending and straightening operations this machine is well adapted since the pressure on the die builds up only as the air pressure builds up on the piston. It is possible then by throttling the air to bring upon the work just sufficient pressure to deflect the work the desired amount and then the pressure is released. If the die travel is stopped by the resistance of the work at any point within the uniform pressure stroke (anywhere beyond half piston stroke) the pressure on the die is a known predetermined amount in direct proportion to the air line pressure. Line air pressure is controllable by a pressure regulating valve within five per cent, thus affording ample control over the working pressures on the die.

Air Tight Cast-Iron Furnace Door

IT is impossible to secure maximum boiler furnace efficiency unless the amount of excess air is maintained within certain pre-determined limits. Leaks in the boiler settings around the furnace doors have a tendency to admit too much air which must be heated to a high temperature and escape through the stack, carrying away many valuable heat units.

Realizing the needs of stopping such leaks, the Conveyors' Corporation of America, Chicago, has developed a new 15 in. by 16 in. cast-iron door, designed to be air-tight and positively prevent the ingress of air or the leakage of gases. This door is especially suited for use on boiler furnaces, being designed for this particular service. It can, however, be used in any place where an air tight cast iron door is needed.

The door is substantially made of cast iron. All bearing surfaces are machined to make an air tight contact. Floating hinges, pivoted to the door at the center insure an even pressure over the door when it is closed and locked. The door can be provided with either of two types of locks—with a wing nut at the end of a hinge bar, or with a lever locking device which is recommended when the door is subjected to frequent opening and closing.

DOUBTLESS MUCH EQUIPMENT manufactured is not ordinarily known about. How to select the best machine adapted to particular needs is a matter of engineering judgment gained through the experience of successful installations in other plants.

The man who buys on price alone doesn't always get what he thinks he does. Correct engineering analysis, a good machine, and subsequent service are worth a fair price. *Factory.*

GENERAL NEWS

The Ashley, Drew & Northern has announced that it will install oil burners on all its locomotives in the near future.

A screw coupling is still used on British rolling stock. According to a statement in the Engineer, London, there were 623 broken couplings on drawbars on passenger trains and 2,558 on freight trains in Great Britain during the first five months of 1922.

A report from Stockholm says that, after tests extending over 10 years, the Swedish State Railway Board has ordered from the Skandinaviska Kullagerfabriken 1,360 ball-bearing boxes for use on 140 wagons. The tests showed that the ball-bearing system possessed great advantages as regards safety in working, saving of power, economy in lubricants, and reduced supervision.

Bad Order Cars

According to the Car Service Division of the American Railway Association, bad order cars showed a reduction during the half month ended July 1 to 14.3 per cent of the total, as compared with 14.6 on June 15.

New Locomotives for Swiss Federal Railways

The Swiss Federal Railways have recently ordered from Swiss factories 20 electric express locomotives with a maximum speed of approximately 56 miles per hour. The locomotives will take about two years to build. During the next four to five years a total of about 100 new electric locomotives are to be built for the Federal Railways.

Roller Bearings for English Cars

The Great Eastern Railway of England has equipped a coach weighing about 60,000 lb. with a set of roller bearings in order that the design may be tested out in service and information obtained in regard to durability, reliability and wear. This bearing was designed by the mechanical department of the road under the direction of Sir Henry W. Thornton, general manager and engineer-in-chief. The rollers are said to be of a special steel, very hard but not brittle, which was developed during the war.

Westinghouse Ships Second Consignment for Chile's Electrification

A second train of electrical equipment for Chile, a part of the Westinghouse Electric & Manufacturing Company's $7,000,000 contract, left the company's East Pittsburgh plant last week.

This second train was dubbed the "International Trade Special." No locomotives have been shipped on this order as yet, however, but this movement will begin shortly. The contract calls for the delivery of 39 locomotives.

The equipment shipped in this consignment included 2,000 k.w. motor generator sets for installation in three sub-stations under construction at Vina del Mar, San Pedro and Llai Llai; transformers, switching equipment for three sub-stations, 15 lightning arresters, three switchboards of 20 panels each and 44 circuit breakers.

Unsafe Practices in Handling Explosives

Numerous important suggestions for avoiding danger from explosive and inflammable articles are contained in Bulletin No. 56, recently issued by the Bureau of Explosives. One of the most important matters discussed is the handling of casinghead gasoline. In spite of the wide publicity given to the dangerous character of this commodity after the disastrous explosions at Ardmore, Okla., in 1915, and at Memphis, Tenn., in 1921, three accidents occurred during May and June as results of failure to observe the rules of the bureau. The bulletin again calls attention to the necessity for relieving internal pressure through the safety valve before dome covers are removed and for cooling cars in case the pressure rises and gas is discharged through the valve. Other causes of accidents noted in the bulletin are the storage of black powder at too short a distance from a car storage yard and disregard of a smoldering fire while handling a car of naphtha involved in a wreck.

Freight Car Loading

A slight increase was shown for the week ended August 12. The total, 852,480, was an increase of 44,311 cars as compared with the corresponding week of 1921 and a decrease of 118,689 as compared with the corresponding week of 1920.

Engineering Societies to Be Represented at Brazilian Exposition

Calvin W. Rice, secretary of the American Society of Mechanical Engineers, has been appointed official delegate to the Engineering Congress to be held in connection with the International Exposition at Rio de Janeiro next month. In addition to the American Society of Mechanical Engineers, Mr. Rice will represent at the congress the Federated Engineering Societies, the American Institute of Electrical Engineers, the Enginering Foundation, the John Fritz Medal Board, the Engineering Division of the National Research Council, the Engineers' Club of New York City, and other organizations.

The Engineering Congress at this exposition is another phase of the worldwide engineering movement sponsored by leading engineers and government officials in the principal countries of the world. Mr. Rice, in addition to his work at the congress, will visit numerous South American engineering centers in behalf of the American Society of Mechanical Engineers and of organized engineering in general. His itinerary includes Rio de Janeiro, Buenos Aires, Santiago, Valparaiso, Callao, and Havana.

Transportation of Natural Gas Gasoline

The results of a study of the hazards involved in the transportation of natural gas gasoline, made by the Bureau of Mines, in cooperation with the Association of Natural Gasoline Manufacturers and the Bureau of Explosives, are given in a report by D. B. Dow, chemical engineer of the Bureau of Mines, which is now being distributed by the Association of Natural Gasoline Manufacturers, 821 Mayo building, Tulsa, Okla. The investigation was undertaken at the request of the Interstate Commerce Commission.

Several very disastrous explosions and fires have occurred in the shipment of natural gas gasoline. The Ardmore, Okla., explosion of September 27, 1915, in which 47 were killed and 500 injured, was the most disastrous. Shipping regulations designed to prevent such accidents have failed in many cases to accomplish their purpose, and new regulations have been proposed in the hope that accidents may be prevented in the future.

It was found that pressure developed in standard cars was much higher than pressure developed in insulated cars, particularly in summer months. Due to this difference in pressure, insulated cars are desirable for the shipment of natural gas gasoline, not only from the standpoint of safety, but also from the standpoint of economy.

Every effort should be expended in prevention of carelessness in unloading tank cars of natural gas gasoline. The men who have charge of unloading should be thoroughly instructed as to proper methods of procedure and be required to pass examinations as to their fitness for this work.

Baldwin Locomotive Works Issues Quarterly Magazine

Under the title "Baldwin Locomotives," the Baldwin Locomotive Works has published the first issue of a periodical devoted to the interest of transportation and motive power problems. It is intended to illustrate from time to time the newest types of locomotives constructed at the Baldwin Works and to present articles on technical or commercial subjects allied to transportation. The first issue, dated July, 1922, contains articles on the first uniform gage transcontinental railway in South America, on the lubrication of railway car journals, and on South American business The locomotives described include the Consolidation type built for the Western Maryland, Santa Fe and Pacific types built for the Argentine state railways and also logging and tank locomotives. The interests of foreign readers have not been overlooked as some of the articles are published in both English and Spanish and the locomotive specifications are given also in French and Portuguese.

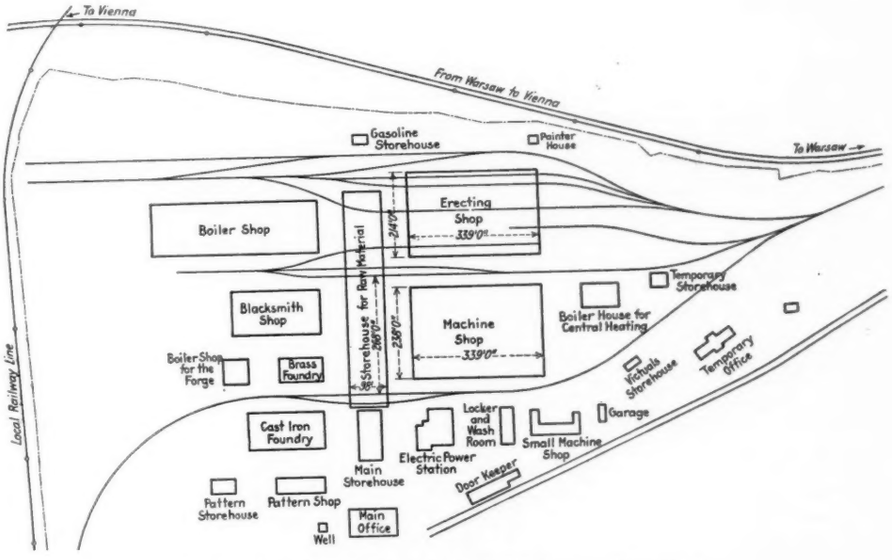
The First Locomotive Works in Poland

J. Dabrowski, Chrzanow, Poland.

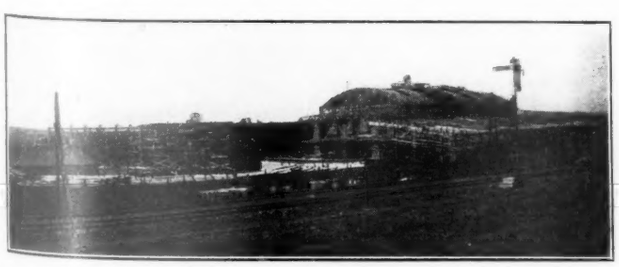
One of the most important problems of the Independent Polish Government and of private industry has been to restore the railways and to increase the number of locomotives. This question became the more vital as the geographical situation of Poland makes it a natural mediator between west and east. For normal transport conditions there are necessary now about 3,000 additional new locomotives, the average number of locomotives needed for 1 klm. of railway track being in Europe about 0.4.

The First Polish Locomotive Works Ltd., Chrzanow, Poland, are really the first step in the development of this industry in Poland and they have received a government order for 1,200 new locomotives. The works in question are advantageously situated near the coal mines and industrial districts of Upper Silesia.

In proportions and arrangement the buildings are unlike the other plants completed during recent years in that country and they embody a number of features that warrant detailed consideration. The main buildings of reinforced concrete are spacious and secure an abundance of natural light by large windows and glass areas in the roof. The erecting shop has ground dimensions of 339 ft. 6 in. by 217 ft. 4 in. and consists of four parallel bays. The bay heights were determined very largely by the crane requirements. The main bay is equipped with a crane runway for two 50-ton cranes with top of rail 36 ft. 1 in. and two 10-ton cranes with top of rail 22 ft. 2 in. above the floor. The machine shop has ground dimensions of 339 ft. 6 in. by 238 ft. 2 in., is divided into seven parallel bays and provided with six cranes ranging from 5 to 15 tons. The position of the other buildings relative to the whole plant is shown in the general plan.



Plan of the Shops of the First Polish Locomotive Works



General View of the First Polish Locomotive Works

As to the internal equipment of the shops it was the policy of the management to apply all technical improvements in both machine tools and working methods. Special machine tools, high speed steel, electric drive, interchangeability of parts, modern systems of shop management were taken into most careful consideration.

All electric current used in the shops is purchased from the neighboring electric power company being received as 22,000 volt 50 cycle, three phase alternating current, which is reduced by transformers to 380 volt three phase 50 cycle current. Rotary converters are also provided to supply 220 volt direct current which is used to operate the variable speed motors of machine tools. All cranes, except those of the cast iron foundry, are operated by alternating current.

The management of the works pays much attention to American industry and American methods of working and has active intercourse with many firms of this country. The present financial difficulties due to the low rate of exchange of Polish money do not permit the realization of many intentions. The first locomotives should be assembled this year.

The First Polish Locomotive Works is a private company with financial support of the Polish banks.

St. Louis Power Plant Will Use Pulverized Fuel

The Union Electric Light & Power Company, a subsidiary of the North American Company, has decided to adopt powdered fuel for its new $6,000,000 power plant now under construction in St. Louis. This plant, of which 60,000 kw. will probably be in operation next year, will have an ultimate capacity of 24,000 kw. and is to supply the increasing industrial and lighting load in St. Louis. The decision to adopt powdered coal as a fuel was made after extensive tests and investigations of stoker equipments and pulverized fuel equipments, including the plant of the Milwaukee Electric Railway & Light Company which has been using powdered coal for sometime with very satisfactory results. Investigation showed that for the conditions which would exist at the St. Louis plant powdered fuel, using mine sweepings, low grade and unmarketable coals, would be more economical than a stoker installation. In the event of emergency, from strikes or other causes, fuel oil may be used in the same furnaces without change.

Labor Board Decisions

ONE ORGANIZATION TO REPRESENT EMPLOYEES.—For several years rules governing the rates of compensation and service of enginehouse employees and fuel handlers on the terminal division of the Boston & Maine have been made by agreement between the management and a committee affiliated with the Knights of Labor. Since September 1, 1917, the rules covering store department employees in oil rooms and enginehouse storerooms on the Boston Terminal have been negotiated between the management and a

similar committee. Under Decision No. 119, and especially principle 15 in Exhibit "B" of that decision, the railway management has considered as one class all laborers in and around shops, enginehouses and storehouses; and has found by vote of the employees that a majority of this class, taking the railroad as a whole, desired to have the United Brotherhood of Maintenance of Way Employees and Railway Shop Laborers represent them. The management accordingly proceeded to negotiate an agreement with a committee from that organization. The employees on the Terminal division contended that the separate agreement with the Knights of Labor should continue. The Labor Board decided that the management acted properly in negotiating an agreement with the maintenance of way organization. This decision, however, does not prevent employees from designating representatives of their choice to handle with the management matters affecting their wages and working conditions, provided such procedure is in conformity with the rules incorporated in the agreement entered into with the maintenance of way organization and the provisions of the Transportation Act.—(*Decision No.* 1121.)

Improved Condition of Palestine Railway System

Local communications have been greatly improved within the past year, and today Palestine enjoys probably the best railway, telephone and telegraph and mail service in the Near East, according to advices from the U. S. Shipping Board representative at Constantinople.

An efficient railway system in Palestine is a heritage of the war. In their military operations the British built the line from Kantara on the Suez canal to a point near Gaza, connecting there with the old pre-war narrow gage system. The gage was broadened and an extension built into Haifa. The system, now 500 kilometers in length, connects with the Egyptian State Railways at Kantara and with the Syrian railways in the north.

The motive power and rolling stock is in first-class condition. American locomotives built in 1918 for the British war department are used, having evidently been turned over to the Palestine railways. A few mountain saddle-tank type locomotives built in Leeds, England, have been added recently. A number of new passenger coaches from England, together with international sleeping cars afford good accommodations to travelers. Daily passenger and mail service are proving beneficial to business.

L. & N. W. Asks Employees for Suggestions

In a circular Arthur Watson, general manager of the London & North Western, asks employees for suggestions as to improved service and efficiency. The circular reads in part:

"It is further recognized that almost every railway employee has ideas concerning the management or working of his railway, but that there has existed a certain amount of diffidence, and in some cases, difficulty, in making known those ideas to some one in authority. Suggestions from the staff on all matters likely to promote the economical working of the concern or to increase the receipts are, therefore, welcomed. Such matters are:

(a) Any new method—mechanical or electrical—which it is believed will result in economy.
(b) The elimination of the waste of engine power, stores and materials.
(c) Improved methods of working trains or road vehicles and accelerating movement.
(d) Improvement in rolling stock and equipment.
(e) Improvements in passenger and goods station working.
(f) Improvements in stationery forms, office methods and equipment.
(g) The prevention of accidents.
(h) The improvement of relations with our customers and the securing of additional business to the company."

MEETINGS AND CONVENTIONS

Steel Treaters and Drop Forgers Will Meet in Detroit

Final arrangements are being made for the fourth international steel exposition and conventions of the American Society for Steel Treating and the American Drop Forging Institute to be held in the General Motors building, Detroit, Mich., Oct. 2-7.

The exposition will be the largest ever held as practically all of the floor space has been sold and many exhibitors who desired to be present cannot be accommodated. There will be quite a number of exhibitors not present at previous shows due to the fact that the Drop Forging Institute is holding its annual convention simultaneously and in the same building with the American Society for Steel Treating.

The General Motors building is especially adapted for exhibition purposes. In the large exhibition hall, there are 30,000 sq. ft. while the two wings on the same floor leading to the exhibition hall have 20,000 sq. ft. of additional display space. Arrangements have been made so that in one section of the hall gas furnaces will be in operation, while electrical furnaces and other equipment requiring power will be displayed throughout the hall. Practically all of the exhibits will be in operation.

At the three previous expositions held at Chicago, Philadelphia and Indianapolis, the attendance has been in excess of 10,000 and it is expected that because of the great interest in Detroit as a heat treating center as well as a market for steel products, the attendance will be in excess of 15,000.

C. I. C. I. & C. F. A. Convention

The annual convention of the Chief Interchange Car Inspectors' and Car Foremen's Association, which was to have taken place at Chicago, August 22-24, has been postponed and will be held at the Hotel Sherman, Chicago, November 6-8.

The following list gives names of secretaries, dates of next or regular meetings and places of meeting of mechanical associations and railroad clubs:

Air-Brake Association.—F. M. Nellis, Room 3014, 165 Broadway, New York City. 1923 annual convention; Denver, first Tuesday in May.

American Railroad Master Tinners', Coppersmiths' and Pipefitters' Association.—C. Borcherdt, 202 North Hamilton Ave., Chigago.

American Railway Association, Division V—Mechanical.—V. R. Hawthorne, 431 South Dearborn St., Chicago.

Division V.—Equipment Painting Division.—V. R. Hawthorne, Chicago. Annual meeting postponed.

Division V.—Purchases and Stores.—W. J. Farrell, 30 Vesey street, New York.

American Railway Tool Foremen's Association.—R. D. Fletcher, 1145 E. Marquette Road, Chicago. Annual convention will be held at the Hotel Sherman, Chicago, September 5-8.

American Society of Mechanical Engineers.—Calvin W. Rice, 29 W. Thirty-ninth St., New York. Railroad Division, A. F. Stuebing, 2201 Woolworth Building, New York.

American Society for Testing Materials.—C. L. Warwick, University of Pennsylvania, Philadelphia, Pa.

American Society for Steel Treating.—W. H. Eiseman, 4600 Prospect Ave., Cleveland, Ohio. Annual convention and exposition postponed until October 2-7, 1922, Detroit, Mich.

Association of Railway Electrical Engineers.—Joseph A. Andreucetti, C. & N. W., Room 411, C. & N. W. Station, Chicago, Ill.

Canadian Railway Club.—W. A. Booth, 53 Rushbrook St., Montreal, Que. Regular meeting second Tuesday in each month, except June, July and August, at Windsor Hotel, Montreal.

Car Foremen's Association of Chicago.—Aaron Kline, 626 N. Pine Ave., Chicago, Ill. Meeting second Monday in month, except June, July and August, Great Northern Hotel, Chicago, Ill.

Car Foremen's Association of St. Louis.—Thomas B. Koeneke, 604 Federal Reserve Bank Building, St. Louis, Mo.

Central Railway Club.—H. D. Vought, 26 Cortlandt St., New York, N. Y. September 14 meeting postponed.

Chief Interchange Car Inspectors' and Car Foremen's Association.—W. P. Elliott, T. R. R. A. of St. Louis, East St. Louis, Ill. Annual convention November 6-8, Hotel Sherman, Chicago.

Cincinnati Railway Club.—W. C. Cooder, Union Central building, Cincinnati, Ohio. Regular meetings second Tuesday, February, May, September and November.

Dixie Air Brake Club.—E. F. O'Connor, 10 West Grace St., Richmond, Va.

International Railroad Master Blacksmiths' Association.—W. J. Mayer, Michigan Central, 2347 Clark Ave., Detroit, Mich. The 1922 annual convention has been cancelled.

International Railway Fuel Association.—J. G. Crawford, 702 East Fifty-first St., Chicago, Ill.

International Railway General Foremen's Association.—William Hall, 1061 W. Wabash Ave., Winona, Minn. The 1922 annual convention has been cancelled.

Master Boilermakers' Association.—Harry D. Vought, 26 Cortlandt St., New York, N. Y.

New England Railroad Club.—W. E. Cade, Jr., 683 Atlantic Ave., Boston, Mass. Regular meetings second Tuesday each month except June, July, August and September, Copley Plaza Hotel.

New York Railroad Club.—H. D. Vought, 26 Cortlandt St., New York, N. Y. Regular meetings third Friday of each month, except June, July and August, at 29 West Thirty-ninth street, New York. Next meeting September 15. H. C. Pearce, director of purchases and stores, Chesapeake & Ohio, will present a paper on The Real Functions of the Department of Purchases and Stores.

Niagara Frontier Car Men's Association.—George A. J. Hochgreb, 623 Brisbare Building, Buffalo, N. Y.

Pacific Railway Club.—W. S. Wollner, 64 Pine St., San Francisco, Cal.

Railway Club of Pittsburgh.—J. D. Conway, 515 Grandview Ave., Pittsburgh, Pa. Next meeting September 28, Fort Pitt Hotel, Pittsburgh. Paper on The Designing and Building of Steel Freight Car Equipment will be presented by J. A. Pilcher, mechanical engineer, Norfolk & Western, Roanoke, Va.

St. Louis Railway Club.—B. W. Frauenthal, Union Station, St. Louis, Mo. Regular meetings second Friday each month, except June, July and August.

Traveling Engineers' Association.—W. O. Thompson, 1177 East Ninety-eighth street, Cleveland, Ohio. Annual meeting changed from September 12-15 to October 31 to November 3, 1922.

Western Railway Club.—Bruce V. Crandall, 14 E. Jackson Boulevard, Chicago. Regular meetings third Monday of each month, except June, July and August.

SUPPLY TRADE NOTES

T. H. Lange has been appointed traffic manager of the Pawling & Harnischfeger Company, Milwaukee, Wis.

G. S. Bigelow, Chicago, representative of the Mountain Varnish & Color Works, Toledo, Ohio, has resigned.

I. S. Kemp, formerly sales manager of the Vaughan & Bushnell Manufacturing Company, Chicago, has been elected vice-president of the Evansville Tool Works, Evansville, Ind.

James Kennedy, president of the Angus Sinclair Company, New York City, and managing editor of Railway and Locomotive Engineering, died suddenly at his home in New York City, on August 14. Mr. Kennedy was born in Forfarshire, Scotland, in 1850. He served his apprenticeship as a railroad machinist in his native land, and came to this country in 1868, and was later foreman of the Singer Machine Company, New York. He studied at night, and graduated from the old Thirteenth street high school, New York, in 1875. He again entered railroad service with the Lackawanna & Bloomsburg, now a part of the Delaware, Lackawanna & Western at Kingston, and was later foreman at Scranton, Pa. From 1879 to 1902 he was foreman at the New York Elevated shops in New York City. For the following year Mr. Kennedy was chief cashier at the Water Department of the City of New York, and in 1904 was deputy superintendent of elections. He contributed for many years to the railroad press, and in 1905 joined the staff of Railway and Locomotive Engineering, and became managing editor in 1911. He was the author of a number of handbooks on locomotive subjects.

James Kennedy

C. H. G. Larrimore has been appointed general manager of the Railway Audit & Inspection Company, Philadelphia, Pa., in charge of all operations, succeeding T. C. Cary, deceased.

G. E. A. Letourneau, manager of the Canadian Gold Car Heating & Lighting Company, Limited, 346 St. James street, Montreal, Canada, died suddenly at his home on August 5.

W. E. Farnan has been appointed director of the special committee on railroad lumber requirements of the Southern Pine Association, with headquarters at New Orleans, La.

Monroe L. Patzig, 206 Eleventh street, Des Moines, Iowa, has been appointed representative of the Conveyors Corporation of America, Chicago. Mr. Patzig's territory is in central Iowa.

Frank S. Martin, senior member of Frank S. Martin & Son, 25 Broadway, New York City, died on July 27. Francis A. Martin will continue to conduct the business under the present name, and with the same staff.

L. H. Matthews, for 19 years connected with the railroad department of Fairbanks, Morse & Co., has resigned to become Pacific Coast manager of the Chicago Metallic Packing Company, with headquarters at Los Angeles.

The Rome Wire Company, Rome, N. Y., has taken an interest in the Atlantic Insulated Wire & Cable Company, Stamford, Conn. The latter company will continue to manufacture its brands of high-grade rubber-covered wires and cables.

The Franklin Moore Company, Winsted, Conn., manufacturers of material-handling machinery for industrial plants, has appointed the Scheid Engineering Corporation, 90 West street, New York City, as its metropolitan and export representatives.

A. L. Roberts, formerly master mechanic of the Lehigh Valley Railroad, and recently chief engineer of the Atlas Crucible Steel Company, has been appointed sales engineer, railroad department, of the United Alloy Steel Corporation, Canton, O.

At a meeting of the directors of the Sharon Pressed Steel Company, Sharon, Pa., on August 9, L. B. LeBel, Edward O. Peck and Harold G. Mosier, of Cleveland, and A. E. Swan, of Sharon, were elected directors to succeed W. L. Ulmer, W. H. Watkins, L. L. Knox and W. J. Parker, retired.

The New York City office of the Chicago Flexible Shaft Company, Chicago, manufacturers of Stewart industrial furnaces, which has been located at 350 Broadway since it was established early in 1920, has been removed to 16 Reade street. The office, as before, is in charge of J. W. Lazear.

The King Pneumatic Tool Company has moved into a new factory at 1735 Armitage avenue, Chicago, with more than double the capacity of the former plant. The company manufactures molybdenum steel riveting hammers, chipping hammers, rivet cutters, electric drills, and a complete line of pneumatic tools and accessories.

J. J. Hennessy and Hugh Bonham have been appointed assistant superintendents of the lubrication division, railway traffic and sales department of the Texas Company, New York. Mr. Hennessy's appointment is for the eastern territory, with headquarters at New York City, and Mr. Bonham's for the western territory, with headquarters at Chicago.

Coleman Sellers, Jr., president of William Sellers & Co., Inc., Philadelphia, Pa., died on August 15. Mr. Sellers was in his seventieth year and had been ill for several months. His connection with the Sellers house began in 1873 immediately after his graduation from the University of Pennsylvania. After serving a practical course in the shops for several years, he took a position in the drafting room, of which he soon became the head. He was appointed assistant manager in 1887, becoming at the same time a director of the company. He was elected engineer in 1902 and president in May, 1905, which last office he held continuously until his death. He was a man of liberal ideas and while his principal inclinations and activities were in mechanical and engineering lines, he took keen interest in many other directions, scientific, literary, educational and the arts, and was active in the civic life of Philadelphia. He was long active in the affairs of the Franklin Institute, of which he was vice-president at the time of his death. He was a member of the Board of Commissioners of Navigation of Pennsylvania, to which he was appointed in 1907. He was active in the affairs of the American Society of Mechanical Engineers, the American Society of Naval Architects and Marine Engineers and the Engineers Club of Philadelphia, of which he was one of the founders. He was president of the Chamber of Commerce from 1909 to 1913. He served as chairman of the local draft board during the early stages of the war.

Coleman Sellers, Jr.

The Pressed Steel Car Company, Pittsburgh, Pa., has recently incorporated in Illinois the Pressed Steel Car Company of Il-

linois, capitalized at $5,000, and the Koppel Industrial Car & Equipment Company, also capitalized at $5,000. The parent company is a New Jersey corporation and the Koppel concern, a subsidiary of Pressed Steel Car, is incorporated in Pennsylvania.

The Tuttle Railway Supply Company, Inc., has opened offices in the Woolworth building, New York City, for the handling of railway supplies and specialties. This company has just been appointed the eastern representative of the Edward S. Woods Company, of Chicago. S. W. Tuttle, president of the Tuttle Railway Supply Company, Inc., was, some years ago, connected with the National Dump-Rodger Ballast Car Company, Chicago, in their shops, and for the past fourteen years has been connected with the American Car & Foundry Company, in the manufacturing, executive and selling departments.

The Air Reduction Sales Company, New York, has under way a program of plant expansion. Sites have been bought for an Airco acetylene plant at Birmingham, Ala.; an oxygen plant at Milwaukee, Wis.; and an acetylene plant and a calorene plant at Pittsburgh, Pa.; at the latter place the company recently completed an oxygen plant. Construction of the plant at Birmingham already has begun, and plans are well under way for putting up the plants at Milwaukee and Pittsburgh. In addition to these new plant installations, the company's facilities for producing oxygen from the air will be enlarged in Buffalo and Minneapolis. The estimated cost of the proposed improvements is over $500,000.

G. A. Blackmore, vice-president of the Union Switch & Signal Company, Swissvale, Pa., has been elected first vice-president and general manager. He entered the service of the Union Switch & Signal Company in July, 1896, and in 1901, he was made chief clerk of the engineering and estimating department at Swissvale. In July, 1904, he was transferred to New York, where he was engaged in work on the Interborough Rapid Transit Subways, the New York terminal of the Pennsylvania Railroad and other large signaling projects. In March, 1909, he was appointed assistant eastern manager, with headquarters in New York, and in April, 1911, was made eastern manager in charge of the New York, Montreal and Atlanta offices, and of sales and construction. He was appointed general sales manager of the Union Company in 1915, and his headquarters transferred to Swissvale, remaining in this capacity until January, 1917, when he was elected vice-president. He now assumes the additional duties of general manager.

G. B. Pierce, who has been connected with the Westinghouse Air Brake Company for the last 12 years as a mechanical expert, at the St. Paul office, has been promoted to air brake engineer and transferred to the Orient where he will act in that capacity both for the Westinghouse Air Brake Company and the Westinghouse Traction Brake Company, in a territory covering Japan, China, Manchuria and Korea. Early in September Mr. Pierce will sail for Japan to associate himself with W. G. Kaylor, manager of the Westinghouse Air Brake interests in the Orient, with whom he expects to make his headquarters in Tokyo. Mr. Pierce was formerly in railroad work. Having served as a fireman, he became an engineman on the Montana division of the Northern Pacific in 1901. He later served as acting road foreman of engines on the same division and for three years was a member of the local examining board on transportation rules at Livingston. In 1910 he left this road to join the Westinghouse Air Brake Company.

F. W. Carter, assistant manager of the heavy traction division, railway department, of the Westinghouse Electric & Manufacturing Company, has resigned to become president of the Louisville Frog & Switch Company, Louisville, Ky. Mr. Carter was graduated in electrical engineering from the Virginia Military Institute in 1912 and in the same year entered the employ of the Westinghouse Company on the graduate student course. Between 1912 and 1916 he filled several important assignments and then took up heavy traction work in the New York office. In 1917 Mr. Carter entered the first Plattsburg Camp and was ordered immediately to France, where he served with the Rainbow division until July 28, 1918, when he was severely wounded in action at Chateau-Thierry and later was honored with the D. S. C. After returning from the service Mr. Carter again entered the railway sales department at East Pittsburgh in charge of heavy traction negotiations. The Louisville Frog & Switch Company, of which Mr. Carter will be president, manufactures manganese frogs, crossings, switches, signals and other railway specialties.

TRADE PUBLICATIONS

Car Construction.—The Canadian Car & Foundry Company, Limited, Montreal, has issued bulletin No. F. 7, describing the steel pit flat cars and depressed center flat cars, each of 160,000 lb. capacity, recently built for the Canadian Pacific; also, bulletin No. P. 4, describing the Canadian Pacific all-steel combination mail and baggage cars.

Cast Iron Storage Tank.—The Conveyors Corporation of America, Chicago, has issued a new booklet describing its American cast-iron sectional storage tank which is designed for holding loose, bulky, dry materials for storage or transfer. The booklet is illustrated with engravings showing the tanks in use at a number of well-known plants. Diagrams give details of construction and a comprehensive table of weights and measures is included.

Powdered Coal Application.—A partial report of the meeting of the Engineers' Society of Western Pennsylvania held on February 1, 1921, and a complete report of the paper on Powdered Coal Equipment at Ford Motor Company Plant, presented at that meeting by H. D. Savage, has been published in a 15-page, illustrated booklet recently issued by the Combustion Engineering Company, New York. Typical steam flow, steam temperature and gas temperature charts are included.

Flood and Searchlights.—The Pyle National Company, Chicago has recently issued supplement 2, of catalog 101, illustrating and describing a series of flood lights and searchlights adapted to the lighting of yards, loading platforms, locomotive coaling operations and construction work and general roundhouse illumination. The bulletin includes a list of parts for this equipment and presents illustrations to show the application of the lights to various kinds of night work.

Locomotive Injectors.—A neatly arranged catalogue of 95 pages has recently been issued by William Sellers & Co., Inc., Philadelphia, Pa., in which its line of injectors and boiler attachments is described and illustrated in detail. The results of high pressure steam tests of a No. 10½, Class N, improved self-acting injector, which were outlined in the October 1906 Journal of the Franklin Institute, are contained in this catalogue, also a number of maintenance and repair hints.

Insulating and Soldering.—A catalogue supplement describing insulating and soldering compounds and announcing the extension of that line of products has been issued by the Westinghouse Electric & Manufacturing Company. The publication is known as 5-A, Supplement No. 2. The materials discussed in the supplement are baking and air-drying varnishes, insulating compounds, finishing materials, including paints, enamels, lacquers, etc., insulating glue, soldering flux, and lubricating oil.

Wrought Iron.—An interesting and well illustrated description of the manufacture of ordinary wrought iron and staybolt iron is contained in a booklet recently issued by the Penn Iron & Steel Company, Creighton, Pa. The book tells briefly the story of the first rolling of iron bars in America, which is followed by an account of the successive stages in the manufacture of the modern product. In addition to the illustrations of rolling mills and test pieces the book contains a table of the weights of round and square bars.

Fuel Oil-Burning Systems.—A new catalogue, consisting of three bulletins and describing mechanical fuel oil-burning systems and fuel oil burners in which the oil is atomized by low or high pressure air and steam, has recently been issued by the Schutte & Koerting Company, Philadelphia, Pa. The catalogue discusses thoroughly the installation, operation and maintenance of oil-burning equipment, its characteristics, requirements and functions, the relative merits of mechanical spray oil burners, the design, purpose and operation of air-control registers, oil-pumping outfits, duplex oil strainers and fuel oil heaters, the general requirements of steam boiler furnaces for burning oil, operation, inspection of the system, lighting the fires, air for combustion, indication of satisfactory operation, number and arrangement of burners, effects of carbon deposits and soot, etc. The catalogue is profusely illustrated and contains over 25 tables of important data compiled from authoritative sources.

EQUIPMENT AND SHOPS

Locomotive Orders

THE ERIE has ordered 30 Mikado type locomotives from the Baldwin Locomotive Works.

THE BALTIMORE & OHIO has ordered 15 Pacific type locomotives from the Baldwin Locomotive Works.

THE POLISH STATE RAILWAYS have ordered 25 Consolidation type locomotives from the Baldwin Locomotive Works.

THE MISSOURI, KANSAS & TEXAS has placed an order with the Lima Locomotive Works, Inc., for 40 Mikado and 5 Pacific type locomotives.

THE ILLINOIS CENTRAL has given an order to the Standard Stoker Company for 25 stokers to be installed on the 25 Santa Fe type locomotives ordered recently from the Lima Locomotive Works.

THE LOUISVILLE & NASHVILLE has ordered 30 Mikado type locomotives from the American Locomotive Company. These locomotives will have 26 by 30 in. cylinders and a total weight in working order of 295,000 lbs.

THE NEW YORK, CHICAGO & ST. LOUIS, reported in the *Railway Mechanical Engineer* of July as having ordered 14 locomotives from the Lima Locomotive Works, has ordered five additional locomotives from the same builder.

THE UNION PACIFIC has ordered 55 Mountain type and 10 Mallet type locomotives from the American Locomotive Company. The Mountain type will have 29 by 28 in. cylinders and a total weight in working order of 345,000 lb. and the Mallet type will have 26 and 41 by 32 in. cylinders and a total weight in working order of 495,000 lb. The company has also ordered 15 2-10-2 type locomotives from the Baldwin Locomotive Works.

Locomotive Repairs

THE NEW YORK CENTRAL is having repairs made to 50 locomotives of various types, at the shops of the Rome Locomotive Works.

Freight Car Orders

THE CANADIAN PACIFIC has ordered 250 refrigerator cars from the National Steel Car Corporation.

THE JACOB DOLD PACKING COMPANY, Buffalo, N. Y., will build 35 refrigerator cars in its own shops.

THE WILCOX COMPANY, Chicago, has ordered 50 hopper cars from the Western Steel Car & Foundry Company.

THE PHILADELPHIA & READING has ordered 100 refrigerator cars from the American Car & Foundry Company.

THE NORTHERN PACIFIC has ordered 1,000 steel center constructions from the Western Steel Car & Foundry Company.

THE TEXAS COMPANY has ordered five tank cars of 5,000 gallons capacity from the Pennsylvania Tank Car Company.

THE ELGIN, JOLIET & EASTERN has placed an order with the General American Car Company for 80 steel underframes.

THE MANATI SUGAR COMPANY, 112 Wall street, New York City, has ordered 50 cane cars from the Magor Car Corporation.

THE CHICAGO, MILWAUKEE & ST. PAUL is reported to have placed an order with A. M. Castle & Co., Chicago, for 750 underframes.

THE CHICAGO, INDIANAPOLIS & LOUISVILLE has ordered 300 composite gondola cars of 50 tons' capacity from the Pullman Company.

THE MATHIESON ALKALI WORKS, New York, has ordered from the General American Tank Car Corporation, 20 tank cars of 15 tons' capacity, for carrying liquid chlorine.

THE WARNER SUGAR REFINING COMPANY, New York, has ordered for the Miranda Sugar Company 150 cane cars of 30 tons' capacity from the Magor Car Corporation.

THE CHESAPEAKE & OHIO has ordered 50 refrigerator cars of 40 tons' capacity from the American Car & Foundry Company which will be built at the company's Berwick, Pa., plant.

THE POLISH GOVERNMENT has ordered 7,000 freight cars from the War Department of the United States Government. These cars were originally built for overseas service during the war.

Freight Car Repairs

THE BOSTON & MAINE is having 1,000 box cars repaired at the shops of the Laconia Car Company.

THE BANGOR & AROOSTOOK is making heavy repairs to 250 box cars in its shops at Derby, Maine.

THE SEABOARD AIR LINE is having 900 box cars repaired at the shops of the Magor Car Corporation.

THE CHICAGO & NORTH WESTERN has ordered repairs to 500 box cars from the American Car & Foundry Company.

THE CHICAGO, BURLINGTON & QUINCY has ordered repairs to 500 gondolas from the Keith Railway Equipment Company.

THE INDIANA GAS & COKE COMPANY has placed an order for repairs to 50 hopper cars with the General American Car Company.

THE CENTRAL OF NEW JERSEY is having 200 steel hopper cars repaired at the shops of the Pressed Steel Car Company and 300 at the shops of the Standard Steel Car Company.

THE LEHIGH VALLEY has ordered repairs to 1,000 high side steel gondola cars. The order was equally divided between the American Car & Foundry Company and the Buffalo Steel Car Company.

THE MISSOURI PACIFIC has placed orders for repairs to 2,500 freight cars as follows: American Car & Foundry Company, 1,250; Sheffield Car & Equipment Company, 1,000; and the Mount Vernon Car Manufacturing Company, 250.

THE CHICAGO & NORTH WESTERN will have 500 box cars repaired at the shops of the American Car & Foundry Company. A contract has also been given for the repair of 1,000 box cars to the Western Steel Car & Foundry Company.

THE CHICAGO, ROCK ISLAND & PACIFIC has placed orders with the Western Steel Car & Foundry Company for repairs to 400 wooden box cars, 300 automobile and furniture cars, 400 steel underframe box cars and 1,500 composite National dump cars.

THE GRAND TRUNK is having 100 refrigerator cars repaired at the shops of the National Steel Car Corporation. This road is also having repairs made to 500 coal cars and 500 box cars; the order being divided between the Canadian Car & Foundry Company and the Eastern Car Company.

THE CHESAPEAKE & OHIO recently placed orders for repairing steel coal cars as follows: Illinois Car & Manufacturing Company, Hammond, Ind., 1,000 cars; Keith Railway Equipment Company, Hammond, Ind., 500 cars; American Car & Foundry Company, Huntington, West Va., 1,500 cars; and Richmond Car Works, Richmond, Va., 1,000 cars.

THE NEW YORK CENTRAL is having 500 coke cars converted to gondola cars at the shops of the Ryan Car Company, Hagewisch, Ill.; 500 coke cars converted into gondola cars at the shops of the Buffalo Steel Car Company, Buffalo, N. Y., and 973 coke cars converted into 500 flat, 300 double deck stock, and 173 single deck stock cars at the shops of the American Car & Foundry Company, Detroit, Mich.; for the Pittsburgh & Lake Erie 1,200 coke cars are being converted into box cars at the shops of the Standard Steel Car Company, Newcastle, Pa.; 300 coke cars converted into box cars at the shops of the American Car & Foundry Company, Detroit, Mich.

Passenger Car Orders

THE NATIONAL RAILWAYS of Mexico have ordered 5 first-class and 10 second-class, narrow gage passenger coaches, from the Pullman Company.

The Canadian Pacific has ordered 15 baggage cars from the National Steel Car Corporation.

The Pittsburgh & West Virginia has ordered nine coaches, one passenger and baggage, two passenger, baggage and mail and two baggage cars from the American Car & Foundry Company.

Machinery and Tools

The Texas-Mexican has ordered a 79-in. driving wheel lathe from the Niles-Bement-Pond Company.

The New York Central has ordered a 60-in. horizontal boring machine from the Niles-Bement-Pond Company.

The Long Island has ordered from the Niles-Bement-Pond Company one 10-ton, 3-motor electric traveling crane.

The Missouri Pacific has ordered one 2,500-lb. single frame steam hammer from the Niles-Bement-Pond Company.

The Chesapeake & Ohio has ordered a 42-in. boring mill and a 1,100-lb. steam hammer, from the Niles-Bement-Pond Company.

The Los Angeles Railway Corporation has ordered a No. 1 car wheel lathe from the Niles-Bement-Pond Company.

The Union Pacific has placed an order with the Industrial Works, Bay City, Mich., for a 15-ton locomotive crane with 45 ft. boom.

The Atchison, Topeka & Santa Fe has placed an order with the Milwaukee Electric Crane & Manufacturing Company, Milwaukee, Wis., for a 15-ton crane.

Shops and Terminals

The Illinois Central has awarded contracts for the construction of water treating plants at Matteson, Galena, Amboy, Ill.; Fort Dodge and Council Bluffs, Ia., to Joseph E. Nelson & Sons, Chicago. Contracts have also been awarded to the Railroad Water & Coal Handling Company, Chicago, for the construction of water treating plants at Wall Lake, Logan, Rockwell City and Denison, Ia.

The Union Pacific.—Contracts have been awarded to the Graver Corporation of Chicago for one 30,000-gallon per hour Graver Type "K" ground operated water softener for Granger, Wyo. This treating plant will be equipped with two standard Graver Corporation of Chicago for one 30,000-gallon per tract also covers the reconstruction of five present treating plants to the improved Graver Type "K" design.

PERSONAL MENTION

MASTER MECHANICS AND ROAD FOREMEN OF ENGINES

W. R. Meeder has been appointed master mechanic of the Missouri & North Arkansas with headquarters at Harrison, Ark., succeeding C. W. Bugbee, who has resigned.

F. W. Boardman, fuel supervisor of the Texas & Pacific with headquarters at Dallas, Tex., has been appointed general master mechanic with the same headquarters. He is succeeded by L. E. Dix.

PURCHASING AND STORES

George Kefer, chief clerk in the purchasing department of the Long Island, has been appointed purchasing agent, succeeding H. B. Hodges, retired.

CAR DEPARTMENT

G. W. Easling, car inspector of the New York Central lines at Corning, N. Y., has been retired after serving with the company for more than 30 years.

C. E. Copp, master painter for the Boston & Maine until his retirement on a pension two years ago, returned to Billerica shops in the early days of the shopmen's strike to assist in supervising the new men taken on to paint equipment. The emergency being over, Mr. Copp has now returned to his summer home at Alton Bay, N. H.

H. Englebright, master car repairer of the Southern Pacific at West Oakland, Cal., has recently retired from active service after 52 years of continuous service with the same road. Born in New Bedford, Mass., June 10, 1852, Mr. Englebright was taken by his parents to California at the age of five, when the gold mines were still the dominant industry in that state. He entered the service of the old California Pacific as a blacksmith apprentice in 1869, and worked at this trade at various points until 1892, when he was appointed roundhouse and car foreman at Fresno, Cal. He was appointed general car foreman at San Francisco in 1898, and master car repairer at Oakland, Cal., in 1900, which position he held continuously until his retirement, after an interesting experience which has seen the linking of the west to the east by the first transcontinental line, the development of motive power from 35-ton to 225-ton locomotives and the introduction and subsequent universal use of the automatic air brake, of which device he has made a particular study.

H. Englebright

GENERAL

W. D. Robb has been appointed ranking vice-president of the Grand Trunk with the title of vice-president and general manager and will take up the duties of Howard G. Kelley, whose resignation as president is announced. He is the first chief executive of the Grand Trunk to have risen step by step, with unbroken service, from an apprenticeship in the company. Mr. Robb was born at Longueuil, Quebec, in 1857, his father having come to Canada from Scotland to join the Grand Trunk in its construction stage. He received his early education at Sherbrooke Academy and at St. Francis College, Richmond, Que. He began his career with the Grand Trunk in 1871 as an apprentice machinist. He was appointed night foreman at the Montreal shops in 1883, and was promoted to the position of foreman at Belleville in charge of the motive power and car department in the same year. In 1897, he was appointed master mechanic of the middle division with headquarters at London, Ont., and in 1901 was made acting superintendent of motive power at Montreal. Mr. Robb was promoted to the office of superintendent of motive power in 1902, a position which he occupied until his appointment in 1917 as vice-president in charge of motive power, car department and machinery. His jurisdiction was extended in 1918 to take in the operating, maintenance and construction departments of the system.

W. D. Robb

OBITUARY

William Andrew Thompson, Jr., one of the vice-presidents of the Texas Company, New York City, died at his home in Brooklyn on July 24.